TECHNICAL MANUAL

OVERHAUL AND
REPAIR INSTRUCTIONS

STORAGE TANK, LIQUID OXYGEN
TYPE TMU-7A/E
2,000 GALLON CAPACITY
PART NO. C70013
NSN 3655-01-245-8408YD

HYDRA-RIG CRYOGENICS, INC.
(F41608-86-D-0268)

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FOREWORD/PREFACE

Purpose. This technical manual will provide the using activity with repair and overhaul instructions for the Liquid Oxygen Storage and Transfer Tank, Type TMU-7A/E.

Scope. This manual will provide the using activity with applicable information required on the disassembly, cleaning, inspection, repair, replacement, assembly, and testing associated with the use of cryogenic equipment and products. Any corrections regarding this technical manual should be submitted in accordance with T.O.00-5-1.

Throughout this manual the unit will primarily be called the Tank. It may also be called the Storage Tank. Tanks referenced but not covered by this manual will contain additional descriptions. Example: supply tank and receiving tank. Liquid oxygen may be referred to as the product, or abbreviated as LOX in parts of this manual.

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SAFETY SUMMARY

The following are general safety precautions which are related to liquid oxygen equipment. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance while using this equipment. Specific precautions will be included in the text for certain potentially hazardous operations in the form of a WARNING or CAUTION statement. The following information appears in the text of this publication and is presented here for emphasis.

QUALIFIED PERSONNEL

Only qualified personnel shall be authorized to operate and perform maintenance on this equipment.

PROTECTIVE EQUIPMENT

Personnel operating and performing maintenance on this equipment shall wear protective clothing and equipment as directed in TO 00-25-172.

BODILY CONTACT

Never allow liquid oxygen or the piping on the equipment to contact the skin. The extremely low temperatures created by liquid oxygen will immediately freeze the body area and result in severe frostbite.

EMERGENCY TREATMENT OF BODILY CONTACT

In the event of bodily contact with liquid oxygen or the Tank piping remove the victum from the exposure immediately. Do not attempt to rewarm any bodily part as this should be accomplished by proper medical personnel. Transport the patient to an emergency room of a hospital or clinic as soon as possible. Keep the patient dry and warm enroute to the emergency room. Upon arrival identify the injury as exposure to liquid oxygen.

UNAUTHORIZED CONTAINERS

Never put liquid oxygen in any container without proper safety devices (e.g. thermos bottle). When heated liquid oxygen will expand rapidly and build pressures to extremely high levels. The results of pressure buildup without safety devices may result in an explosion.

KEEP AWAY FROM ABSORBENT MATERIALS

Liquid oxygen must be kept away from absorbent materials such as rags, wood, paper, and clothing. These materials may trap the oxygen gas and later be ignited by any source of spark or flame.

SAFETY SUMMARY —CONTINUED

KEEP AWAY FROM HYDROCARBONS

Liquid oxygen is not compatible with hydrocarbons. Forms of hydrocarbons are oils, greases, gasoline, tar, and asphalt. Liquid oxygen in contact with hydrocarbons present a severe explosive hazard. The equipment, its components, and tools used in maintenance must be kept free of hydrocarbons.

SMOKING

Do not smoke or permit smoking within fifty (50) feet of Tanks in liquid oxygen service. Do not carry sources of flame in the vicinity of Tanks in liquid oxygen service. Use caution in smoking immediately after being exposed to liquid oxygen vapors as these vapors may be still trapped in clothing.

VENTILATION

Adequate ventilation must be provided for personnel for Tank functions such as transfer operations, filling, draining, purging, painting, welding, brazing, and cleaning.

LIFTING

Equipment used in lifting and moving the Tank must be of sufficient rating to handle the weights involved.

PART CLEANNESS

All parts used in liquid oxygen service must be kept clean and free of hydrocarbons. Never use shop air to dry cleaned parts. Ultraviolet lights are used to check parts that have been cleaned. Overexposure to ultraviolet light can result in conjunctivitis (inflammation of the inner eyelid and eyeball) and possible skin burns which could result in skin cancer.

PURGING

When purging a Tank all piping and valves become hot enought to burn. Ensure Tank components are at ambient temperatures before attempting handling or removal after purging operations.

PAINTING

Paint and coatings may affect skin, eyes, and respiratory functions. Proper ventilation is a must and avoid repeated contact when possible.

SAFETY SUMMARY—CONTINUED

WELDING AND BRAZING

Welding or brazing operations produce heat, metal fumes, injurious radiation, metal slag, and airborne particles. Proper equipment must be worn before welding or brazing. Never look directly at the arc when welding or the flame during brazing. Never attempt welding or brazing operation near Teflon components (e.g. anti-seize tape). Teflon components deteriorate at high temperatures and emit poisonous gases. Proper ventilation is a must when welding or brazing.

TANK VACUUM

Never break the vacuum in the annular space with liquid product in the Tank. The liquid product must be drained.

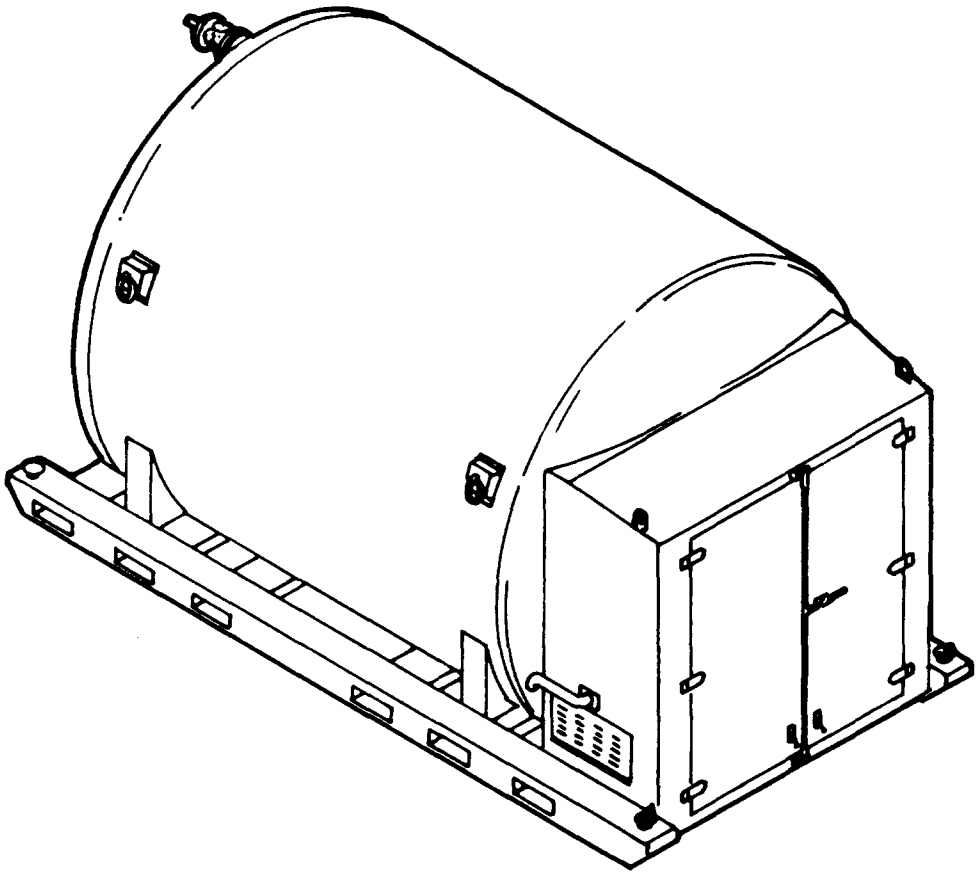


Figure 1-1. Tank, Storage, Liquid Oxygen, Type TMU-7A/E.

SECTION I
GENERAL INFORMATION

1-1 GENERAL INFORMATION.

1-1.1 Purpose. This manual contains repair and overhaul instructions. These instructions are for a Storage Tank, Liquid Oxygen, TMU-7A/E. The Tank has a storage capacity of 2000 gallons. The Tank was built by Hydra Rig Cryogenics, Inc., Schulenburg, Texas under part number C70013 (Figure 1-1).

1-1.2 Type. The Tank is Support Equipment and is to be accorded maintenance management under provisions of AFR 66-1. Only fully trained and qualified personnel shall be authorized to repair and overhaul any equipment involving liquid oxygen (Refer to T.O. 00-25-172). The Tank is intended for the storage and transfer of aviator's liquid breathing oxygen. Conversion of this Tank to store liquid nitrogen is authorized only as provided by AF Regulation 57-4.

1-1.3 Scope. These instructions enable the user to accomplish the following:

a. Disassemble the Tank.

b. Repair the Tank.

c. Repair and replace defective parts.

d. Perform cleaning and inspection procedures.

e. Reassemble the Tank.

f. Test the Tank to ensure that it is in a serviceable condition.

1-1.4 Repairs. All repairs must be conducted in a well ventilated area to prevent a concentration of vapors from venting and spillage of the product. All safety precautions shall be followed. The necessity of maintaining the cleanliness of parts which come into contact with liquid oxygen cannot be over emphasized.

1-2 PURPOSE OF EQUIPMENT.

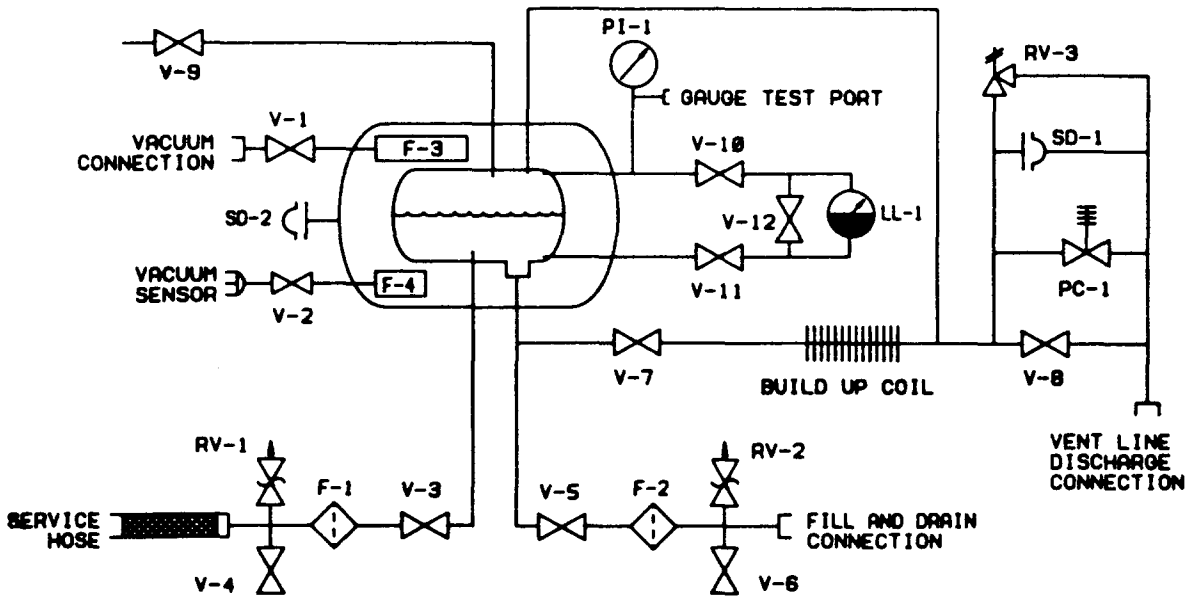
1-2.1 Purpose of Equipment. The Tank is designed for the storage of liquid product and the transfer of the product into smaller servicing tanks. It will store up to 2000 gallons of product at its atmospheric boiling temperature (-297 ° F).

1-2.2 Physical Description. The Tank is a complete, self-contained unit, consisting of a 2000 gallon cryogenic storage tank, controls, indicators, and appropriate piping for the receiving and transfer of a liquid product. Table 1-1 presents the leading particulars for this assembly. Components are illustrated in Figure 1-2.

a. TANK ASSEMBLY. The Tank assembly consists of an inner shell, for the containment of liquid product, suspended inside an outer shell. The space between the two (2) shells is the annular space which is filled with powdered insulation.

b. VACUUM LINE SHUTOFF VALVE. The vacuum line shutoff valve is at the upper rear surface of the Tank. This assembly, per USAF Drawing 66C1627, is used for the withdrawal of air from the annular space.

c. CONTROL HOUSING. The control housing is mounted at the front of the Tank for protection of the controls, piping, and indicating instruments. Two (2) hinged doors are provided at the front of the housing. When these doors are opened complete access is available to all control valves and indicators which have required nameplates. Two (2) smaller side doors are provided for removal and re-installation of the pressure buildup coil. All parts within the control housing can be removed and replaced without removing the control housing.



SD-1 INNER SHELL SAFETY HEAD
SD-2 OUTER SHELL SAFETY HEAD
F-1 SERVICING LINE FILTER
F-2 FILL/DRAIN LINE FILTER
F-3 VACUUM FILTER
F-4 VACUUM INDICATOR FILTER
LL-1 TANK LIQUID LEVEL INDICATOR
PI-1 VAPOR PHASE PRESSURE INDICATOR
RV-1 SERVICING LINE PRESSURE RELIEF VALVE
RV-2 FILL/DRAIN LINE PRESSURE RELIEF VALVE
RV-3 INNER SHELL PRESSURE RELIEF VALVE
V-1 VACUUM LINE SHUTOFF VALVE
V-2 VACUUM INDICATOR SHUTOFF VALVE
V-3 SERVICING LINE SHUTOFF VALVE
V-4 SERVICING LINE DRAIN VALVE
V-5 FILL/DRAIN LINE SHUTOFF VALVE
V-6 FILL/DRAIN LINE DRAIN VALVE
V-7 PRESSURE BUILDUP CONTROL VALVE
V-8 VAPOR VENT LINE SHUTOFF VALVE
V-9 FULL TRYCOCK VALVE
V-10 LEVEL INDICATOR ISOLATION VALVE (VAPOR)
V-11 LEVEL INDICATOR ISOLATION VALVE (LIQUID)
V-12 LEVEL INDICATOR EQUALIZER VALVE
PC-1 ADJUSTABLE PRESSURE CONTROL

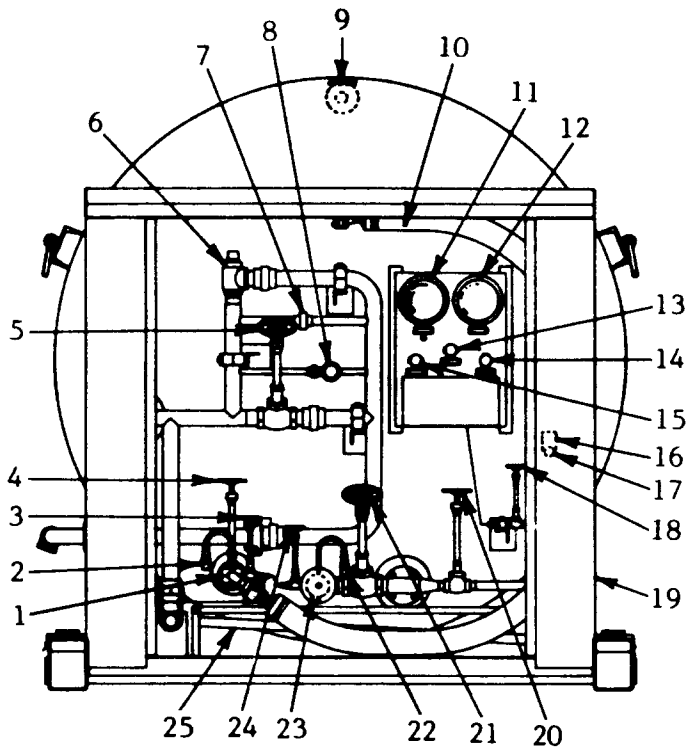
Figure 1-2. Tank Flow Schematic Diagram.

If removal of the control housing is required only a part of the vent line, the vent line adapter plate, and twenty-eight (28) nuts, bolts, and washers need to be removed. Two (2) lifting eyes are provided at the top of the control housing for lifting the housing from the Tank.

d. SERVICING HOSE AND LINE. The servicing line is located on the left side of the control housing and terminates in the service hose assembly. The line consists of three (3) manifold sections, a service coupling, filter, drain valve, shutoff valve, pressure relief valve, and pipe clamp with its retaining bolts.

e. FILL/DRAIN LINE (FDL). The FDL is located in the center of the control housing. The FDL consists of three (3) manifold sections, a FDL coupling, filter, drain valve, shutoff valve, pressure relief valve, and pipe clamp with its retaining bolts.

1. Servicing Line Filter (F-1)
2. Servicing Line Relief Valve (RV-1)
3. Servicing Line Drain Valve (V-4)
4. Servicing Line Shutoff Valve (V-3)
5. Vapor Vent Line Shutoff Valve (V-8)
6. Inner Shell Pressure Relief Valve (RV-3)
7. Inner Shell Safety Head (SD-1)
8. Adjustable Pressure Control (PC-1)
9. Vacuum Line Shutoff Valve (V-1)
10. Service Hose
11. Vapor Phase Pressure Indicator (PI-1)
12. Tank Liquid Level Indicator (LL-1)
13. Level Indicator Isolation Valve (V-12)
14. Level Indicator Isolation Valve (Vapor V-10)
15. Level Indicator Isolation Valve (Liquid V-11)
16. Vacuum Indicator Shutoff Valve (V-2)
17. Vacuum Sensor
18. Full Trycock Valve (V-9)
19. Control Housing
20. Pressure Buildup Control Valve (V-7)
21. Fill/Drain Line Shutoff Valve (V-5)
22. Fill/Drain Safety Relief Valve (RV-2)
23. Fill/Drain Line Filter (F-2)
24. Fill/Drain Line Drain Valve (V-6)
25. Pressure Buildup Coil



NOTE: Instrumentation, piping, and valves are not shown for clarity. This illustration is for component identification only.

Figure 1-3. Component Identification.

f. VAPOR VENT LINE (VVL). The VVL passes through the left side of the control housing. It is connected to the vapor vent manifold also located on the left side of the control housing. Vapor may be directed into the vent by opening the vapor vent line shutoff valve on the manifold. In the event of excessive pressure buildup in the Tank vapor can be vented by the inner shell pressure relief valve or inner shell safety head located on the manifold. The external vent line directs vapor away from the unit. The vent MUST BE KEPT CLEAR of all obstructions, including caps and plugs, at all times.

g. PRESSURE BUILDUP COIL (PBC). The PBC is located at the bottom of the control housing. Liquid product is admitted to the PBC by opening the pressure buildup control valve. As liquid product enters the PBC it expands to provide pressure to the Tank.

h. CONTROL PANEL (CP). The CP is located on the right side of the control housing. It consist of the vapor phase pressure indicator, Tank liquid level indicator, level indicator isolation valve (vapor), level indicator isolation valve (liquid), level indicator equalizer valve, and a plaque with the Tank flow schematic and operating instructions.

1-2.3 Leading Particulars. A summary of leading particulars for the Tank appears in Table 1-1.

1-2.4 Related Publications. This repair and overhaul manual is written for use in conjunction with the Illustrated Parts Breakdown, T.O.37C2-8-29-4 and the Operation and Maintenance Instructions, T.O.37C2-8-29-1 and the publications listed therein. Both manual contain complementary information regarding the same equipment (Refer to Table 1-2).

1-2.5 Safety Precautions. Safety precautions related to liquid oxygen and this Tank are listed in the Safety Summary. Safety precautions which are related to specific procedures will appear in the text.

Table 1-1. Leading Particulars.

Identification:.....Liquid Oxygen Storage Tank, Type TMU-7A/E
Manufacturer:.....Hydra Rig Cryogenics, Inc., Schulenburg, Texas
Part Number:.....C70013
National Stock No. (NSN):.....3655-01-245-8048YD

Capacity:
- Gross Volume.....2100 gallons
- Net Volume.....2000 gallons

Weight:
- Empty.....12,000 Pounds
- Full (Oxygen).....31,054 Pounds

Evaporation Rate:.....Less than 70 lbs. of liquid oxygen per 24 hours

Over-All Dimensions:
- Length.....192 inches
- Width.....96 inches
- Height.....96 inches

Operating Pressure (Inner Tank).....50 psig
Max. Allowable Working Pressure (MAWP).....59 psig

Relief Valve Settings:
- Inner Tank (RV-3).....59 psig
- Fill/Drain Line (RV-2).....150 psig
- Servicing Line (RV-1).....150 psig

Safety Head Settings:
- Inner Tank (SD-1).....72 psig
- Annular Space (SD-2).....0.1 LB. Above atmospheric pressure

Table 1-2. Related Publications.

Publication No.	Title
T.O.00-5-1	AF Technical Order System
T.O.00-25-107	AFLC Area Support
T.O.00-25-172	Ground Servicing of Aircraft and Static Grounding/Bonding
T.O.00-25-223	Integrated Pressure Systems and Components
T.O.00-25-224	Welding High Pressure and Cryogenic Systems
T.O.00-25-229	Valves and Regulators
T.O.33D2-10-60-1	Cryogenic Sampler
T.O.34Y5-3-37-1	Operation and Maintenance Instructions Power Driven Rotary Vacuum Pump
T.O.00-35D-54	USAF Material Deficiency Reporting and Investigating System
T.O.35-1-3	Painting and Marking of USAF Aerospace Ground Equipment
T.O.37C2-8-29-3	Liquid Oxygen Storage Tank, Overhaul and Repair Instructions
T.O.37C2-8-29-4	Liquid Oxygen Storage Tank, Illustrated Parts Breakdown
T.O.37C2-8-1-116WC-1	Inspection Work Cards
T.O.37C2-8-27-11	Operation, Maintenance and Overhaul Instructions with Illustrated Parts Breakdown for Meter, Dual Efficiency
T.O.37C11-3-1	Vacuum Gage (Portable), Part No. 15840
T.O.36G2-3-1	Air Purging Unit, Type GSU-62/M
T.O.37C11-1-1	Cleaning of Pressure Gages Used
T.O.42B6-1-1	Quality Control of Oxygen
AFOSH-STD-127-66	Occupational Safety General Industrial Operations
AFR-144-1	Fuels Management
MIL-STD-1359A	Cleaning Methods and Procedures for Breathing Oxygen Equipment
MIL-STD-808(USAF)	Finishes, Protective, and Codes for Finishing Schemes for Ground Support Equipment
T.O.35-1-3	Corrosion Prevention, Painting and Marking of USAF Support Equipment (SE)

SECTION II

SPECIAL TOOLS AND TEST EQUIPMENT

2-1 GENERAL.

2-1.1 Scope. Special tools and test equipment required for the repair, overhaul and testing of the Tank and its components are listed in Table 2-1. Items recommended (Figures 2-1 and 2-2) are approved tools and test equipment if available. Equivalent items may be used if recommended items are not available.

2-1.2 Consumable Materials. Materials used for repair and overhaul operations are listed in Table 2-2. Approved equivalent tools and materials can be substituted where appropriate.

Table 2-1. Special Tools and Test Equipment List.

SPECIAL TOOLS AND EQUIPMENT LIST

Tool/Equipment Number	Figure Number	Nomenclature	Use and Application
NSN4310-00-323-8866 Part No. 806889	-	Vacuum Pump, electric, 220/240 VAC	Evacuation (Pump out) Operations
NSN6680-01-117-9931YD 50C-0016-1	2-2	Dual Efficiency Meter	Check boil off rate to determine efficiency of annulus vacuum
NSN6685-00-115-9602YD Part No. 15840	2-1	Vacuum Gage	Check annular space vacuum
Type GSU-62M	-	Air Purging	Purging Operations

Table 2-2. Consumable Materials List.

Material	Specification	Federal Stock No.
Solvent, Trichlorotrifluoroethane (Cleaning Compound)	MIL-C-81302	6850-00-681-5688
Leak Detection Compound, Oxygen System, Type 1	MIL-C-25567C	6850-00-621-1820
Grease, Stopcock (LOX compatible)	KEL-F-90	9150-00-475-2760
Grease, Vacuum	DV 6M (MIL-G-27617)	-
Tape, Antiseize, Tetafluoroethane, 1/2 Inch	MIL-T-27730	8030-00-889-3535
Nitrogen	BB-N-411, Type 1, Grade A	6830-00-285-4769
Brazing Rod or Wire	QQ-B-654A	-
Brazing Flux	O-F-499c	-
Oil, Vacuum Pump	MIL-L-83767 Type II	-
■ Alcohol, Isopropyl	TT-I-735	-

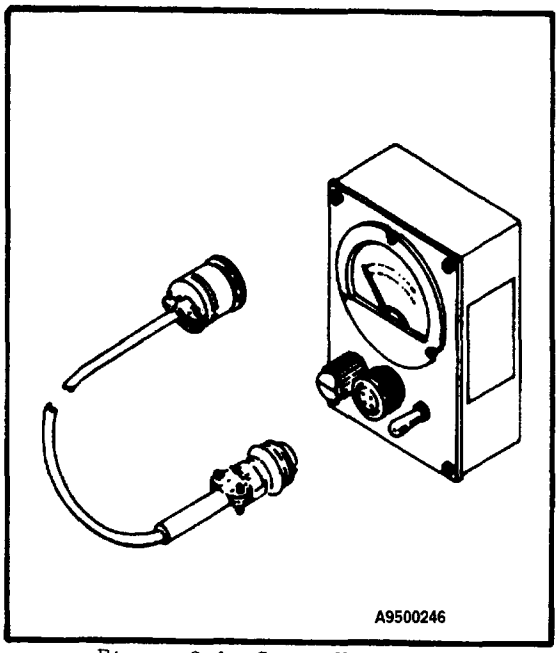


Figure 2-1. Gage, Vacuum.

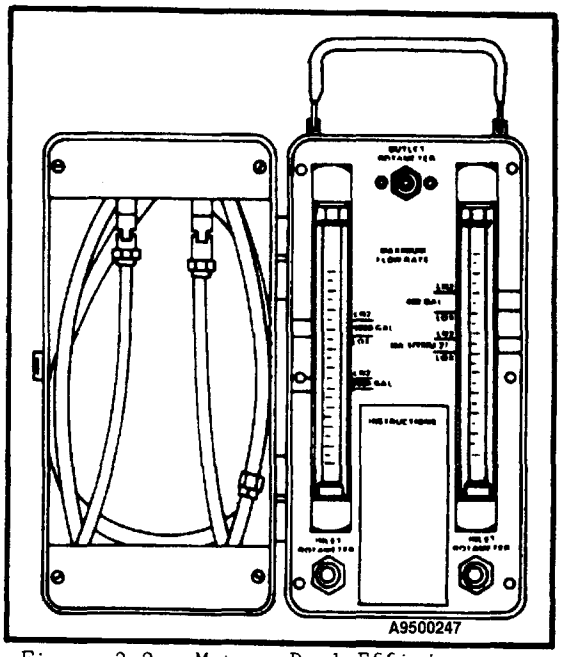


Figure 2-2. Meter, Dual Efficiency.

SECTION III
DISASSEMBLY

3-1 GENERAL PROCEDURES.

3-1.1 Scope. This section contains instructions for disassembling the Tank. These instructions provide for the removal of all components down to the authorized level of repair. These instructions provide for further dismantling of components where parts may be replaced, cleaned, tested, or inspected.

3-1.2 Preparations and Precautions. Certain general precautions and preparations must be considered prior to disassembly of any assembly, subassembly, or component of the Tank. A review of the following paragraphs is recommended before any disassembly is attempted.

a. All procedures must be accomplished in a clean, well ventilated area of sufficient size to facilitate handling operations of liquid oxygen tanks. An environmentally controlled area is ideal but may be impractical. Maintenance and repair personnel must take every precaution to assure the maximum cleanliness of all parts.

b. Parts removed that may be reused should be cleaned and certified as suitable for liquid oxygen service before reassembly. Use polyethylene bags to protect all clean parts and to seal all piping outlets until ready for assembly.

c. Disassembly of the Tank and its components should be limited to those necessary for repair, replacement, required cleaning, or inspection. Components of the Tank that are removed solely for access to other components should be tagged and laid aside for subsequent reassembly. If removed parts are in contact with either the product or the vacuum, they must be protected against contamination by polyethylene bags and stored in a suitable place for subsequent reassembly.

d. Tanks used in liquid oxygen service and tools in contact with liquid oxygen parts must be kept completely free of hydrocarbon oils and greases.

e. During disassembly and handling of components exercise care to avoid any damage. Use particular care to avoid scratching or otherwise defacing flared tube mating surfaces and valve seats.

f. The Tank may be lifted and moved by crane lifting using slings or cables. Forklifts may be used also to lift the Tank. Always maintain the Tank in a horizontal position when lifting. Refer to the Operational and Manintenance Instructions, T.O.37C2-8-29-1, for additional lifting instructions.

g. Only appropriate tools for any particular application may be used in disassembly or assembly of the Tank. This will reduce damage, distortion, and breakage of parts.

h. Subassemblies removed intact (e.g. manifolds or valves) shall be supported in a suitable holding fixture or vise during disassembly or assembly.

i. Tag all parts for identification during disassembly. This will prevent confusion of similar parts during Tank assembly.

j. Riveted, photoetched, and adhesive attached (e.g. decals or nameplates) parts should not be removed except for replacement. Nameplates may be removed from valve stems by removing the bolts and nuts which secure the clamps. Taping over decals or nameplates with suitable tape may reduce damage during assembly or disassembly.

k. Remove and discard gaskets and preformed packings (O-rings) exposed during disassembly. As a general rule these parts should be replaced during assembly. Exceptions will be noted at appropriate places in this manual.

l. Remove all anti-seize tape from any threaded fitting during disassembly. Remove all particles of the tape and take care that none enters the system.

m. All valves on the Tank are threaded instead of sivler-brazed. Globe valve malfunctions can be corrected without removing the valve bodies from the piping manifolds. Exception to this is leakage between the valve body and the piping.

n. The servicing line pressure relief valve (RV-1), fill/drain line pressure relief valve (RV-2), inner shell pressure relief valve (RV-3), level indicator isolation valves (V-10, Vapor and V-11, Liquid), and level indicator equalizer valve (V-12) have threaded connections. These valves can be removed and inspected. If these valves are found to be in an unservicable condition they should be condemned and replaced on reassembly.

3-2 DISASSEMBLY.

3-2.1 General. Only qualified personnel will be authorized to disassemble or repair the Tank. Safety precautions must be followed.

a. Prior to disassembly the Tank shall be drained in accordance with procedures outlined in T.O.37C2-8-29-1.

b. After draining, perform the purging procedures outlined in Section V as necessary.

3-2.2 Disassembly Procedures. The disassembly of the Tank is generally in the order of the index numbers assigned to components in Figures 3-1 through 3-10. Instructions first outline procedures for complete disassembly. Since this may not always be desirable, necessary, and practical to effect repairs procedures are also given for component disassembly. The steps for component disassembly reference steps in the complete disassembly. Disassemble the Tank only to the extent required for replacing defective parts. In some instances, disassembly instructions are included for components which are not disassembled or removed from the Tank except for obvious failure (e.g. vacuum line shutoff valve (V-1)). The instructions for the removal of these items will be preceeded by a note of caution to prevent accidental tampering which could delay a mission. The orderly disassembly of the Tank is as follows:

3-2.2.1 Control Housing (CH) Removal and Disassembly (See Figure 3-1). The CH protects the control valves, indicators, and piping. The Tank has been designed for repair or replacement of Tank components within the CH without requiring the CH to be removed. Removal of the CH should be limited to repair of the CH backplate or replacement of the CH due to its weight (approximately 400 lbs). When removal is required two (2) lifting eyes on top of the CH have been provided for lifting. Lifting should be done with a crane using common slings or cables. Two (2) hinged front doors provide access to Tank components inside the CH. Two (2)

smaller hinged doors, one (1) on each side of the CH, provide access for removing or installing the pressure build-up coil. Removal of the CH and its components is as follows:

a. Control Housing.

[1] Disconnect the service hose from the CH wall.

[2] Remove the vapor vent line (Refer to paragraph 3-2.2.6, a, steps 3 through 5 in this section).

[3] Remove nuts (1), lock washers (2), flat washers (3), bolts (4), and flat washers (5). There are 8 on the top, 12 on the sides attaching the CH to the CH backplate. There are 6 attaching the CH to the Tank skid.

CAUTION

Make sure the lifting assemblies are secured to prevent seperation from the control housing during lifting.

[4] Connect suitable lifting assemblies to the lift eyes on top the CH. Remove the CH slowly.

[5] Remove nuts (7), lock washers (8), bolts (9), and flat washers (10) and remove door (11). Repeat this also for door (12).

[6] Remove nuts (7), lock washers (8), bolts (9), and flat washers (10) from the hinges (13) and remove (13). Repeat this procedure for each hinge on both doors.

[7] Remove nuts (14), lock washers (15), bolts (17), and flat washers (16), nuts (18), lock washers (19), bolts (20), and flat washers (21) from the door lock (22) and remove (22). Remove nuts (23), lock washers (24), screws (25), and flat washers (26) from the door latch (27) and remove (27).

[8] Remove nuts (28), lock washers (29), screws (30), and flat washers (31) from door latch (32) and remove (32).

[9] Remove nuts (33), lock washers (34), screws (35), and door holder (36) from the doors (11 and 12).

[10] Remove nuts (37), lock washers (38), screws (39), and door holder plate (40) from the Tank skid.

[11] Remove nuts (41), lock washers (42), bolts (43), lock washers (44), and hinge (45) from the side doors (46). Drill out rivets (47) and remove door latchs (48).

[12] Remove nuts (49), lock washers (50), bolts (51), flat washers (52), and hose bracket (53). Remove nuts (54), bolts (55), and strap (56). Remove nuts (57), lock washers (58), bolts (59), and strap brackets (60). Remove nuts (61), lock washers (62), screws (63), and strap catch (64).

[13] Tag and store all removed parts until reassembly.

b. Front Door.

[1] Refer to 3-2.2.1, a, step 5.

[2] To further disassemble the right door refer to 3-2.2.1, a, steps 6, 7, and 9.

c. Front Door Hinges.

[1] Refer to 3-2.2.1, a, step 6.

d. Front Door Lock and Lock Plate.

[1] Refer to 3-2.2.1, a, step 7.

e. Front Door Lock Catch.

[1] Refer to 3-2.2.1, a, step 8.

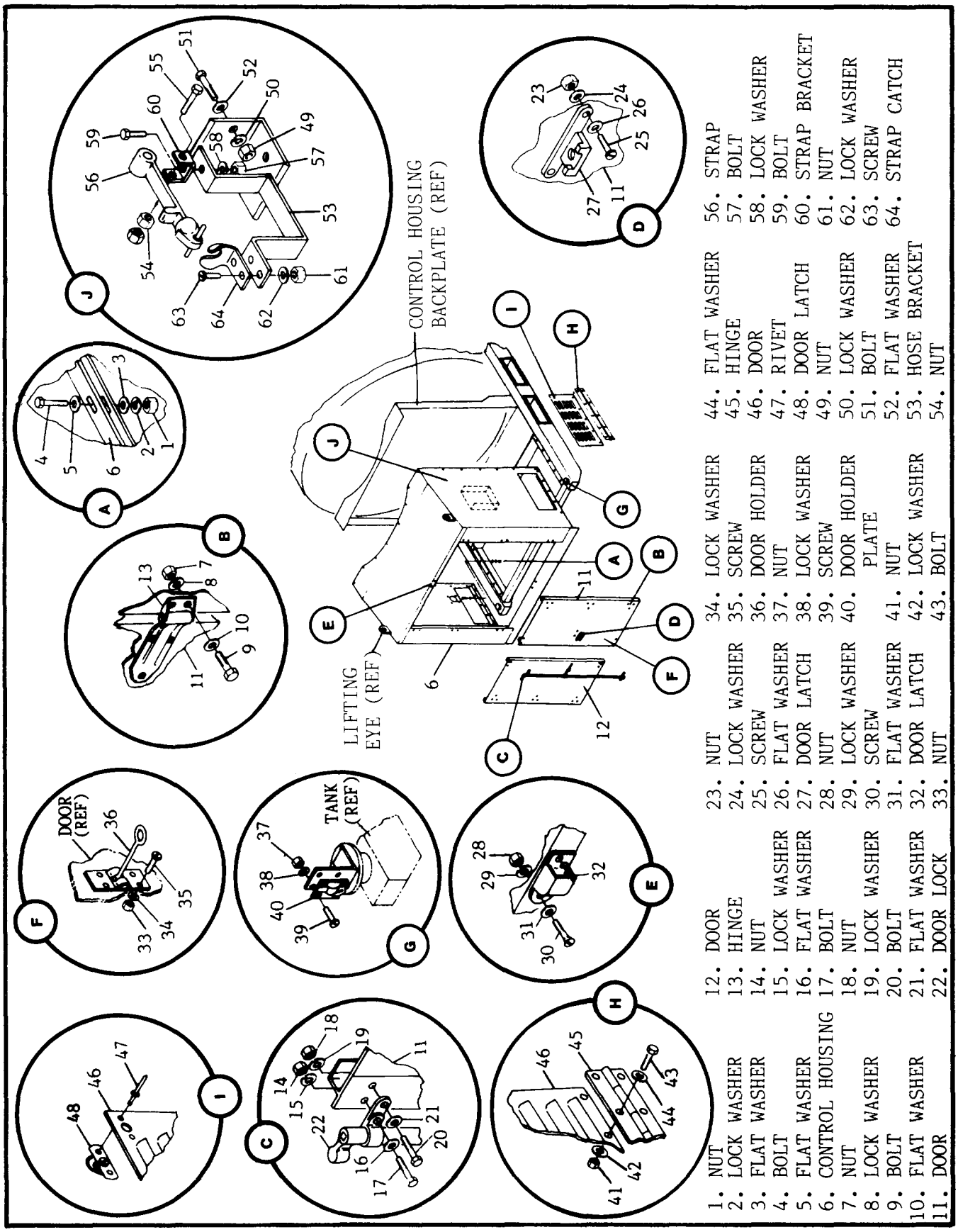


Figure 3-1. Control Housing and Components.

f. Front Door Holder.

[1] Refer to 3-2.2.1, a, steps 9 and 10.

g. Side Door Hinge and Latch.

[1] For both doors refer to 3-2.2.1, a, step 11.

h. Hose Bracket.

[1] Refer to 3-2.2.1, a, step 12.

3-2.2.2 Service Hose (SH) and Hardware Disassembly (See Figure 3-2). The service hose provides a means to transfer liquid product from the Tank to a receiving tank. A coupling is installed for liquid oxygen service (right-hand threads) along with a dust cap.

a. Removal From Control Housing.

[1] Disconnect the SH from the Tank service line coupling. Install the dust cap on the service line LOX coupling to prevent moisture and from entering the line.

[2] Unlatch the clamps inside the control housing and lifting the SH, remove it from the control housing.

[3] Remove nut (1) and flat washer (2) from the pipe nipple (8).

[4] Holding the 1 inch nipple (8) securely, grip the coupling (3) and disconnect it from (8). Further disassembly of the coupling (3) is achieved by removing the retaining ring (5) and separating the coupling nut (7) and the coupling cone (6). Repeat this step for items (11 thru 12).

[5] Holding the hose adaptor flats remove nipples (8 and 13). DO NOT ATTEMPT TO REMOVE HOSE ADAPTOR FITTINGS.

[6] Tag and store all removed parts until reassembly.

b. LOX Couplings.

[1] Refer to 3-2.2.2, a, steps 3 4, and 5.

3-2.2.3 Servicing Line (SL) Removal and Disassembly (See Figure 3-3). The SL consists of the LOX coupling, SL drain valve (V-4), SL shutoff valve (V-3), SL presssure relief valve (RV-1), SL filter (F-1), manifold sections, and associated hardware. Disassembly of the SL is as follows:

a. Servicing Line.

[1] Remove the LOX coupling (1) from the relief/drain manifold (16). The coupling (1) may be further disassembled by removing the dust cap (2) and the gasket (4) from the coupling seat (3).

[2] Remove the short drain line (5) and long drain line (6). Remove the drain line tee (7).

[3] Open V-4 (8) all the way and remove the stem/bonnet assembly (9) from the valve body (10) by disconnecting the bonnet ring on (9). Remove (9) from the drain/relief manifold (16). Remove RV-1 (11) from (16) while maintaining a firm support with an appropriate tool on the relief valve line.

[4] Remove bolts (12) from pipe clamp (13). Remove the top portions (14 and 15) of (13).

[5] Remove the drain/relief manifold (16) from filter F-1 (17) while maintaining support on Filter F-1.

[6] Providing support, remove (17) from the manifold nipple (18). Remove (18) from the body (21) of V-3 (19).

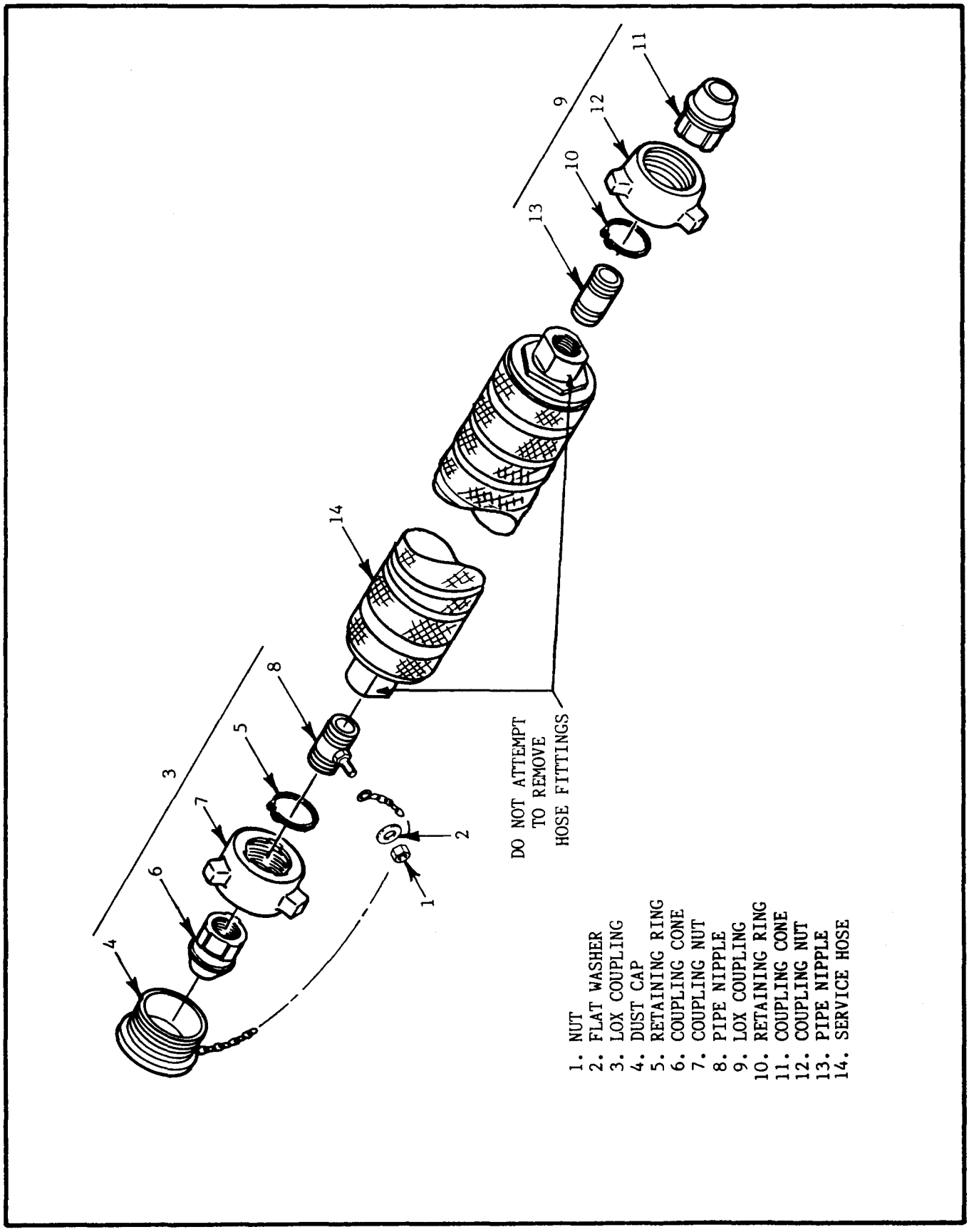


Figure 3-2. Service Hose and Components.

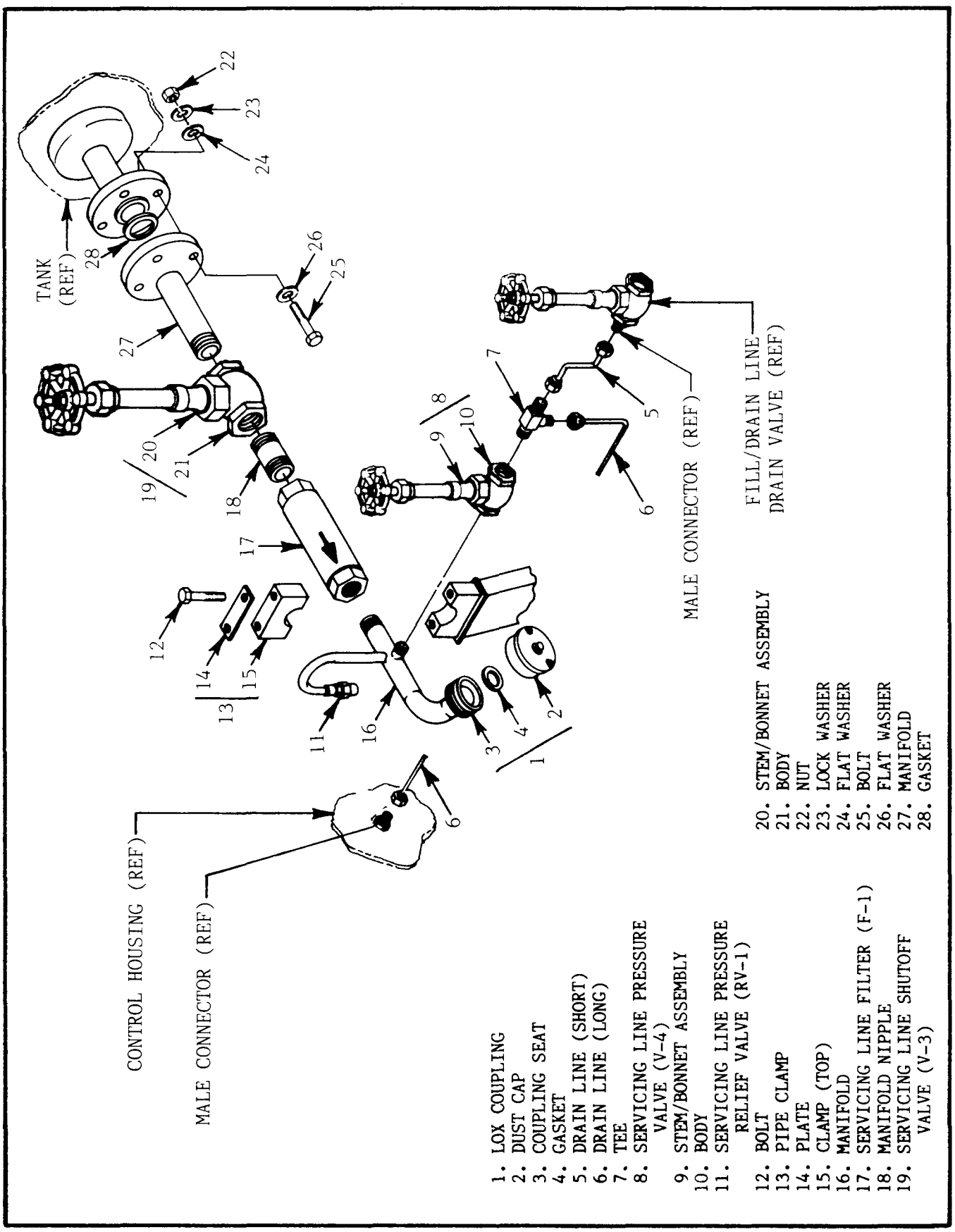


Figure 3-3. Servicing Line and Components.

[7] Open V-3 all the way and remove the stem/bonnet assembly (20) from the valve body (21). Remove (21) from the flange manifold (27).

[8] Remove nuts (22), lock washers (23), flat washers (24), bolts (25), and flat washers (26) from the flange manifold (27).

[9] Remove (27) after the bolts have been removed and remove gasket (28).

[10] Tag and store all removed parts until reassembly.

b. LOX Coupling.

[1] Refer to 3-2.2.3, a, step 1.

c. Drain Line.

[1] Refer to 3-2.2.3, a, step 2.

d. Drain and Relief Valves.

[1] Refer to 3-2.2.3, a, steps 2 and 3.

e. Pipe Clamp.

[1] Refer to 3-2.2.3, a, step 4.

f. Filter.

[1] Refer to 3-2.2.3, a, steps 1, 2,3,4,5 and 6.

g. Shutoff Valve.

[1] Refer to 3-2.2.3, a, steps 1, 2,3,4,5,6 and 7.

3-2.2.4 Fill/Drain Line (FDL) Removal and Disassembly (Figure 3-4). The FDL consists of the LOX coupling, FDL drain valve (V-6), FDL shutoff valve (V-5), FDL pressure relief valve (RV-2), FDL filter (F-2), manifold section, and associated hardware. The FDL also connects with the pressure buildup control valve (V-7). Disassembly of the FDL is as follows:

a. Fill/Drain Line.

[1] Remove the LOX coupling (1) from the hex bushing (5). The coupling (1) may be further disassembled by removing the dust cap (2) and the gasket (4) from the coupling seat (3).

[2] Remove (5) from the drain/relief manifold (20).

[3] Remove the short drain line (6) from male connector (7) and the drain line tee. Remove (7) from body (10) of V-6 (8).

[4] Open V-6 (8) all the way and remove the stem/bonnet assembly (9) from the valve body (10) by disconnecting the bonnet ring on (9). Remove (10) from the drain/relief manifold (20). Remove RV-2 (19) from (20) while maintaining a firm support with an appropriate tool on the relief line to prevent damage.

[5] Remove bolts (11) from the pipe clamp (12). Remove the top portions (13 and 14) of (12). Remove nuts (15), lock washers (16), bolts (17), and support brace (18).

[6] Remove drain/relief manifold (20) from filter F-2 (21).

[7] To prevent damage to the PBC, refer to paragraph 3-2.2.5, Pressure Buildup Coil (PBC) removal and disassembly, before proceeding to step number 8.

[8] Remove filter F-2 (21) from the manifold elbow (22). Remove (22) from the body (25) of V-5 (23).

[9] Open V-5 (23) all the way and remove the stem/bonnet assembly (25) from the valve body (24) by disconnecting the bonnet ring on (25). Remove (24) from the flange manifold (35).

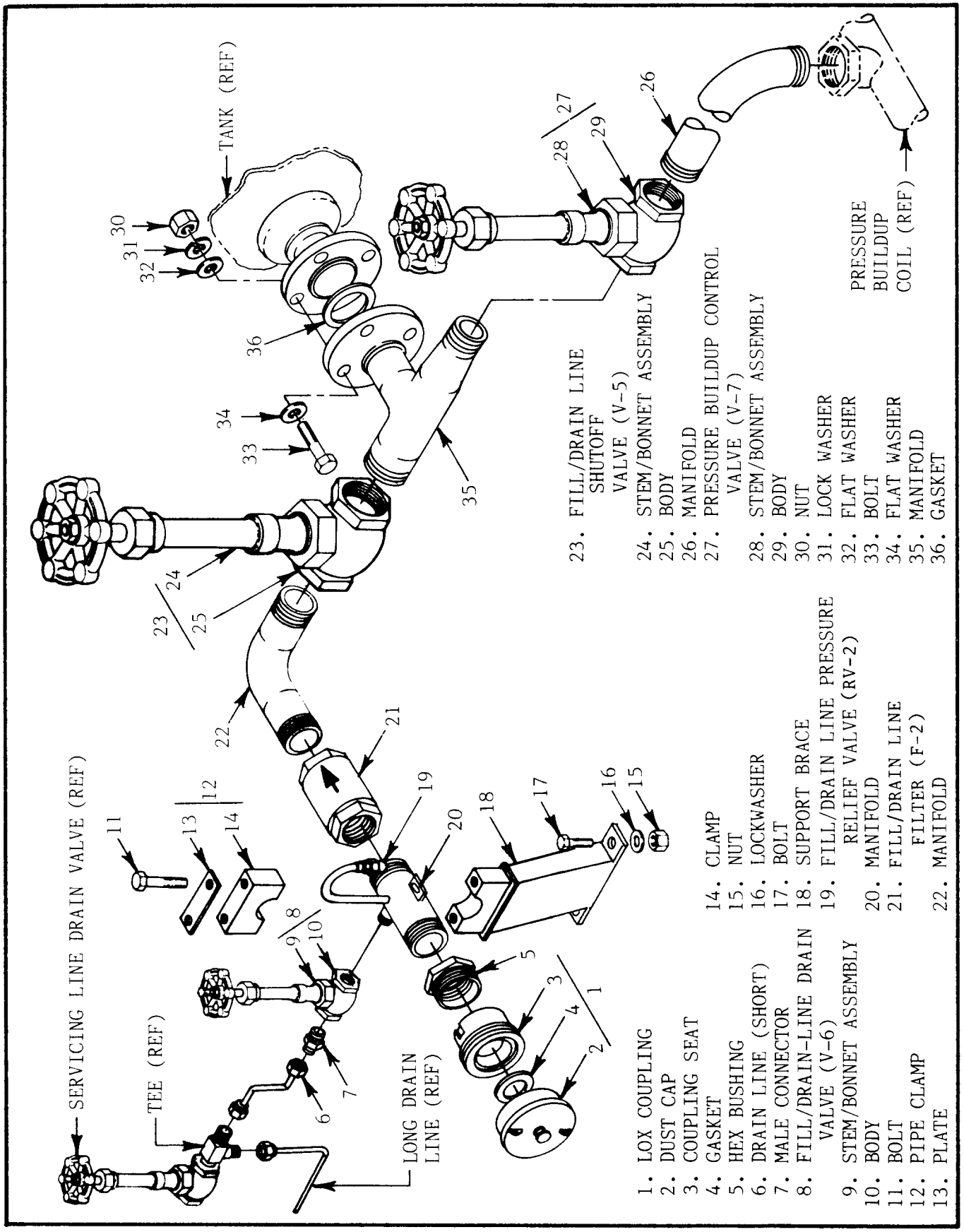


Figure 3-4. Fill/Drain Line and Components.

[10] Remove the pressure buildup manifold (26) while maintaining support on body (29) of V-7 (27).

[11] Open V-7 (27) all the way and remove the stem/bonnet assembly (28) from the valve body (29) by disconnecting the bonnet ring on (28). Remove (29) from the flange manifold (35).

[12] Remove nuts (30), lock washers (31), flat washers (32), bolts (33), and flat washers (34) from the flange manifold (35).

[13] Remove flange manifold (35) after the bolts have been removed the remove gasket (36).

[14] Tag and store all removed parts until reassembly.

b. LOX Coupling.

[1] Refer to 3-2.2.4, a, step 1.

c. Bushing.

[1] Refer to 3-2.2.4, a, steps 1 and 2.

d. Drain Lines.

[1] Refer to 3-2.2.4, a, step 3.

e. Drain and Relief Valves.

[1] Refer to 3-2.2.4, a, steps 3 and 4.

f. Pipe Clamp.

[1] Refer to 3-2.2.4, a, step 5.

g. Filter.

[1] Refer to 3-2.2.4, a, steps 1, 2, 3, 4, 5, 6, 7, and 8.

h. Shutoff Valve.

[1] Refer to 3-2.2.4, a, steps 1, 2, 3, 4, 5, 6, 7, 8, and 9.

i. Pressure Buildup Valve.

[1] Refer to 3-2.2.4, a, steps 7, 10, and 11.

3-2.2.5 Pressure Buildup Coil (PBC) Removal and Disassembly (Figure 3-5). The PBC consists of the coil, pressure buildup manifold, unions, and associated hardware. Disassembly of the PBC is as follows:

a. Pressure Buildup Coil.

CAUTION

When handling the pressure buildup coil care should be taken to prevent damage to the fins on the tubes. Removal of the pressure buildup coil should not be rushed.

[1] Loosen unions (1 and 2) at each end of the PBC. The unions should be loosened so they can be removed by hand but still threaded enough to hold the PBC (7).

[2] Loosen nuts (3) enough to loosen but hold the PBC (7) on U-bolts (5) that are against the Tank backplate.

[3] Remove nuts (3), flat washers (4), and U-bolts (5) on front side of PBC (7). Remove nuts (9), flat washers (10) and bolts (11) from left outer mounting bracket (12) and remove bracket (12).

[4] Disconnect union (2) on the lower right side end of the PBC. If necessary prop an appropriate brace under the PBC's end to prevent a sudden drop when removing union (1) on the higher left end.

[5] Slowly slide the PBC (7) towards the front of the Tank enough to

clear the rear U-bolts (5) while preventing the PBC from dropping. Carefully remove the PBC (7) out through the small door on the left side of the control housing.

[6] Install union cap (6) on vent manifold and cover exposed opening to prevent contamination from entering manifold.

[7] Tag and store all removed parts until reassembly.

3-2.2.6 Vapor Vent Manifold (VVM) Removal and Disassembly (Figure 3-6). The VVM consists of the vapor vent line shutoff valve (V-8), adjustable pressure control valve (PC-1), inner shell safety head (SD-1), inner shell pressure relief valve (RV-3), unions, and associated hardware. Disassembly is as follows:

a. Vapor Vent Manifold.

[1] Loosen unions (1,2,3,4 and 5) until they turn freely.

[2] Loosen bolts (6,10 and 14) enough to allow piping (24 and 25) lateral movement.

[3] Remove nuts (18), lock washers (19), bolts (20), and flat washers (21).

[4] Slide vent line adapter plate (22) along vent line (24) away from the control housing.

[5] Remove bolts (6) and pipe clamp (7). Disconnect (1) and remove (24).

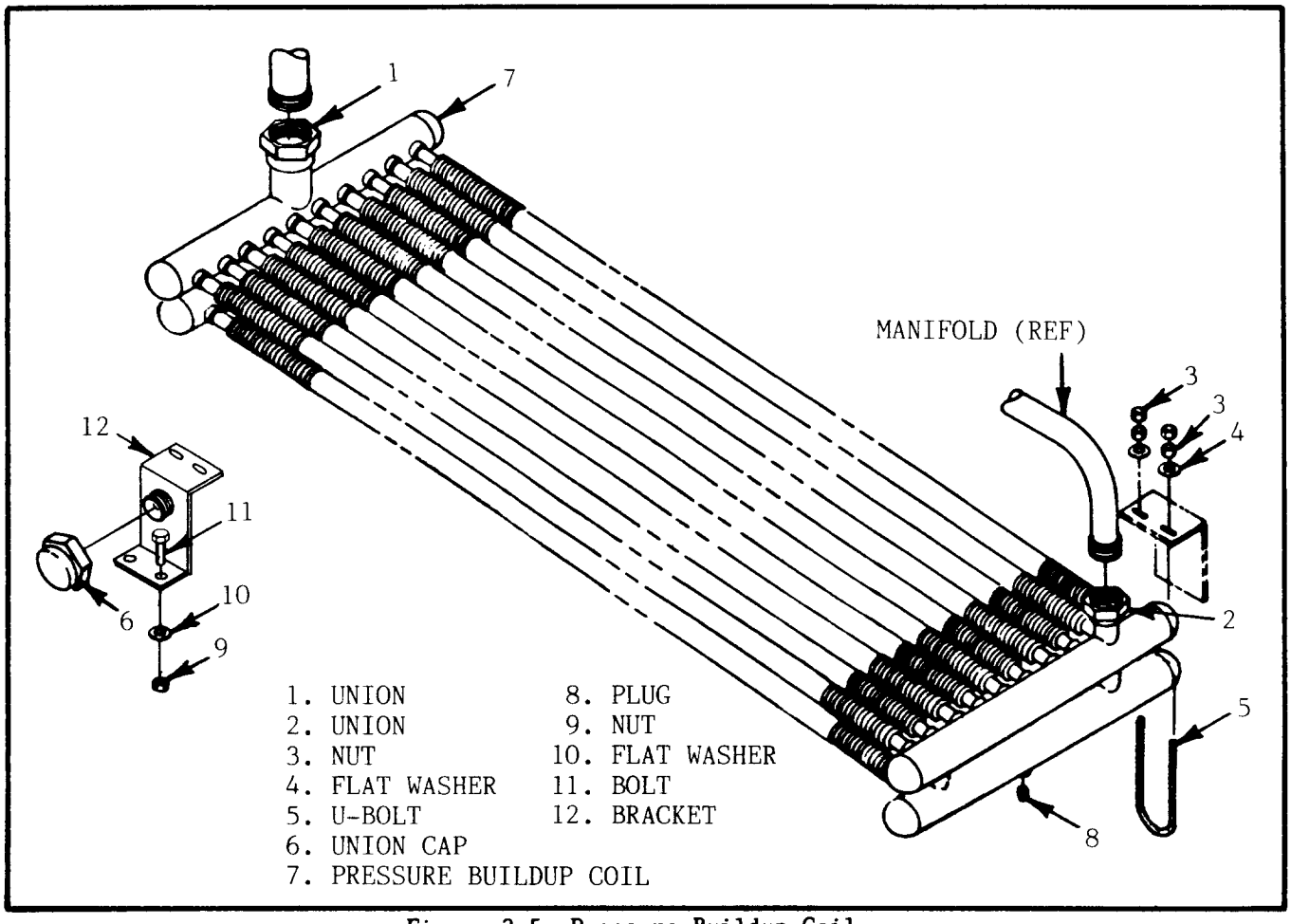
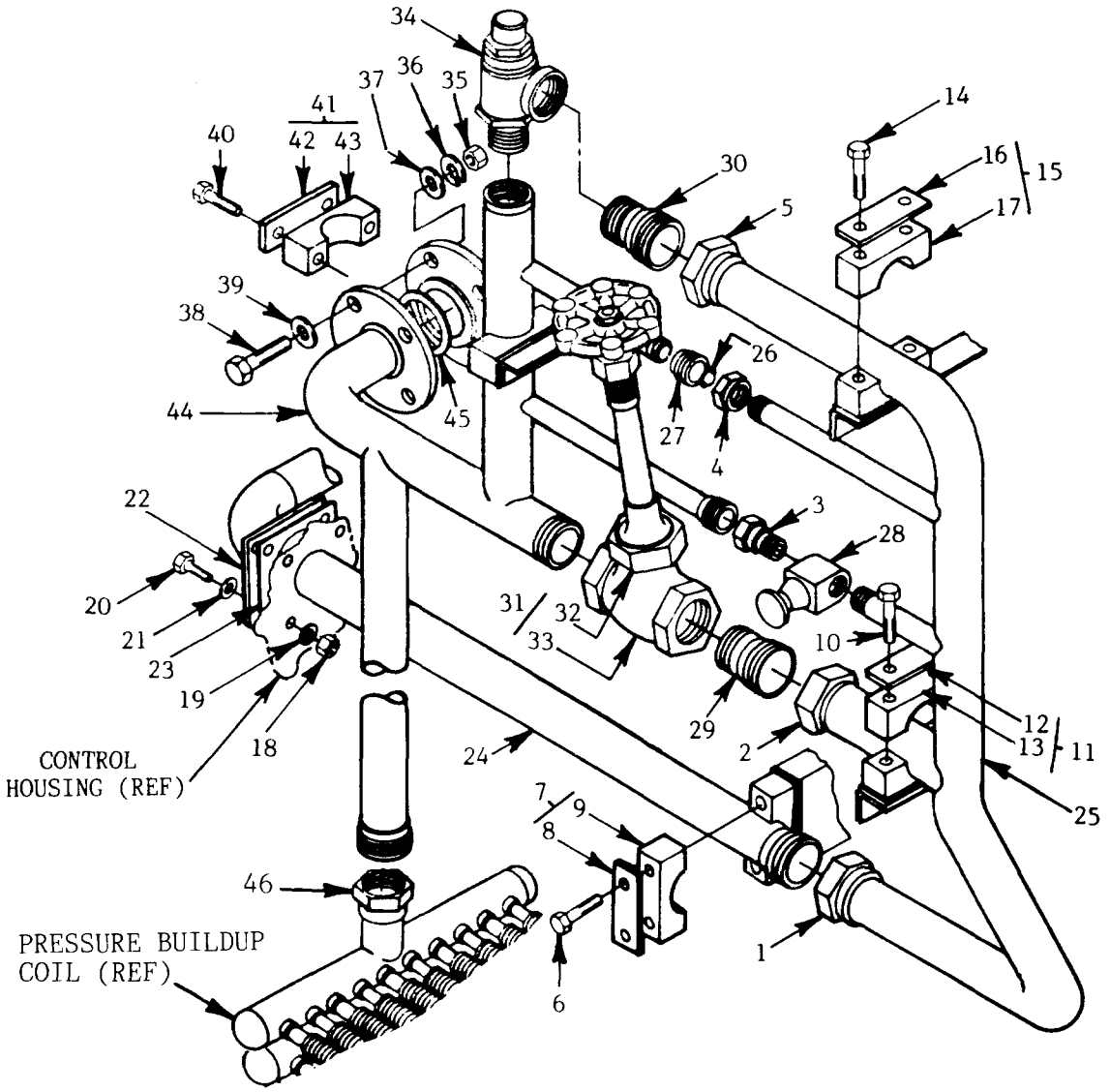


Figure 3-5. Pressure Buildup Coil.



1. UNION
2. UNION
3. UNION
4. UNION
5. UNION
6. BOLT
7. PIPE CLAMP
8. PLATE
9. CLAMP (TOP)
10. BOLT
11. PIPE CLAMP
12. PLATE
13. CLAMP (TOP)
14. BOLT
15. PIPE CLAMP
16. PLATE
17. CLAMP (TOP)
18. NUT
19. LOCK WASHER
20. BOLT
21. FLAT WASHER
22. VENT LINE ADAPTOR
23. GASKET
24. VENT LINE
25. MANIFOLD
26. SAFETY HEAD (SD-1)
27. UNION
28. PRESSURE CONTROL VALVE (PC-1)
29. UNION
30. UNION
31. VAPOR VENT LINE SHUTOFF VALVE (V-8)
32. STEM/BONNET ASSEMBLY
33. BODY
34. INNER SHELL PRESSURE RELIEF VALVE (RV-3)
35. NUT
36. LOCK WASHER
37. FLAT WASHER
38. BOLT
39. FLAT WASHER
40. BOLT
41. PIPE CLAMP
42. PLATE
43. CLAMP (TOP)
44. MANIFOLD
45. GASKET
46. UNION

Figure 3-6. Vapor Vent Manifold and Components.

[6] Slide manifold (25) to the right side of control housing.

[7] Remove inner shell safety head (SD-1) (26). Remove union (3) and adjustable pressure control valve (PC-1) (28). Remove union (4). Remove bolts (10) and pipe clamp (11).

[8] Support manifold (25) so it will not fall and remove bolts (14) and pipe clamp (15). Remove manifold (25).

[9] Remove union halves (27,29, and 30).

[10] Open V-8 (31) all the way and remove the stem/bonnet assembly (32) from the valve body (33) by disconnecting the bonnet ring on (32). Remove (33) from the manifold (44).

[11] Remove inner shell pressure relief valve (RV-3) (34).

[12] Disconnect PBC union (46). Remove nuts (35), lock washers (36), flat washers (37), bolts (40), and flat washers (39). Remove bolts (40) and the pipe clamp (41). Remove manifold (44) and gasket (45).

[13] Tag and store all removed parts until reassembly.

b. Vapor Vent Shutoff Valve.

[1] Refer to 3-2.2.6, a, steps 1 2 and 6.

[1] Remove union half (29).

[2] Refer to 3-2.2.6, a, step 10.

c. Pressure Control Valve.

[1] Refer to 3-2.2.6, a, steps 1, 2 and 6.

[2] Remove union half (3).

[3] Remove Pressure Control Valve (28).

d. Inner Shell Safety Head.

[1] Refer to 3-2.2.6, a, steps 1, 2 and 6.

[2] Remove safety head (26).

e. Inner Shell Pressure Relief Valve.

[1] Refer to 3-2.2.6, a, steps 1, 2 and 6.

[2] Remove union half (30).

[3] Remove inner shell pressure relief valve (34).

3-2.2.7 Control Panel (CP) and Full Trycock Valve (V-9) Removal and Disassembly (Figure 3-7). The CP consists of the vapor phase pressure indicator (PI-1), Tank liquid level indicator (LL-1), level indicator isolation valve (vapor) (V-10), level indicator isolation valve (liquid) (V-11), level indicator equalizer valve (V-12), a panel of the Tank flow schematic and operating instructions, component tags, indicator and valve tubing, and associated hardware. V-9 has been included with the CP. Removal of the CP and V-9 is as follows:

a. Control Panel.

[1] Remove line tube (1) at the connections.

[2] Remove male connector (2) from welded elbow on Tank.

[3] Remove line tube (3) at the female connectors.

[4] Remove male connector (4) from welded elbow on Tank.

[5] Remove nuts (5), lock washers (6), and bolts (7). Remove the control panel (8).

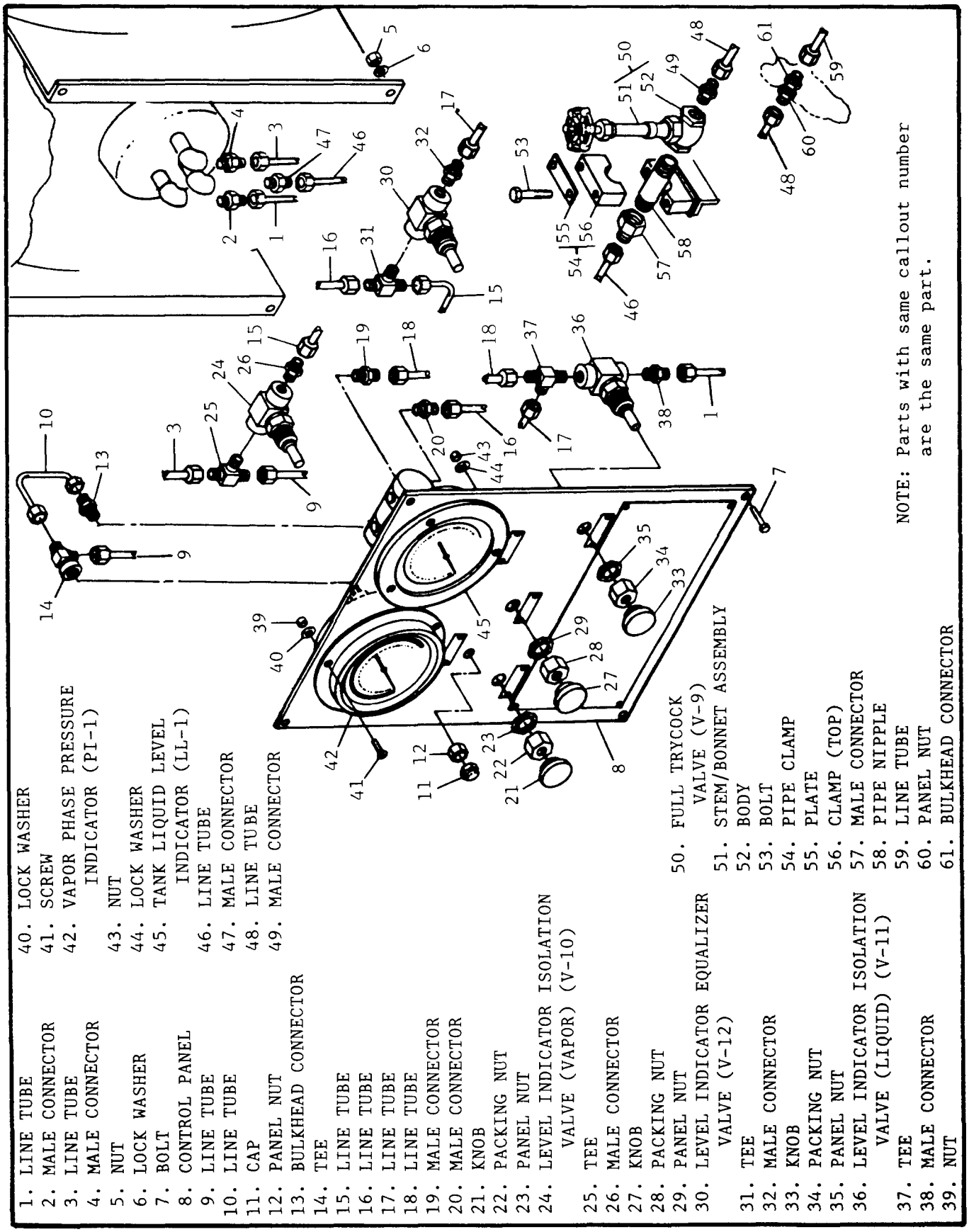


Figure 3-7. Control Panel and Components.

NOTE

Support the control panel in a suitable support, if available, to continue disassembly of the remaining components. Protect the decals.

[6] Remove line tube (9).

[7] Remove line tube (10), cap (11), panel nut (12), and bulkhead connector (13).

[8] Remove tee (14) from the vapor phase pressure indicator (PI-1) (42).

[9] Remove line tubes (15, 16, 17, and 18).

[10] Remove male connectors (19 and 20) from the Tank liquid level indicator (LL-1) (43).

NOTE

The male connectors in LL-1 can be removed after LL-1 is removed from the panel.

[11] Remove knob (21), packing nut (22), panel nut (23), and level indicator isolation valve (24).

[12] Remove tee (25) and male connector (26).

[13] Remove knob (27), packing nut (28), panel nut (29), and level indicator equalizer valve (V-12) (30).

[14] Remove tee (31) and male connector (32).

[15] Remove knob (33), packing nut (34), panel nut (35), and level indication isolation valve (liquid) (V-11) (36).

[16] Remove tee (37) and male connector (38).

[17] Remove nuts (39), lock washers (40), screws (41) and PI-1 (42).

[18] Remove nuts (43), lock washers (44), and LL-1 (45).

[19] Remove line tube (46) at connections and male connector (47) from welded elbow on the Tank.

[20] Remove line tube (48) and male connector (49).

[21] Open V-9 (50) all the way and remove the stem/bonnet assembly (51) and body (52) of the full trycock valve (50).

[22] Remove bolts (53) and pipe clamp (54) top portions (55 and 56).

[23] Remove male connector (57) and pipe nipple (58).

[24] Remove line tube (59), panel nut (60), and bulkhead connector (61).

[25] Tag and store all removed parts until reassembly.

b. Indicator Isolation Valve (Vapor).

[1] Refer to 3-2.2.7, a, steps 3 and 6.

[2] Remove line tube (15).

[3] Refer to 3-2.2.7, a, steps 11 and 12.

c. Indicator Equalizer Valve.

[1] Remove line tubes (15,16 and 17).

[2] Refer to 3-2.2.7, a, step 13 and 14.

d. Indicator Isolation Valve (Liquid).

[1] Remove line tubes (1,17 and 18).

[2] Refer to 3-2.2.7, a, step 15 and 16.

e. Vapor Phase Pressure Indicator.

[1] Remove line tubes (9 and 10).

[2] Remove tee (14).

[3] Refer to 3-2.2.7, a, step 17.

f. Liquid Level Indicator.

[1] Remove line tubes (16 and 18).

[2] Remove connectors (19 and 20).

[3] Refer to 3-2.2.7, a, step 18.

g. Full Trycock Valve.

[1] Remove line tube (48) and connector (49).

[2] Refer to 3-2.2.7, a, step 21.

3-2.2.8 Globe Valve (GV) Disassembly (Figure 3-8). The GV consists of these major assemblies: handle, stem, bonnet, disc, and body. These assemblies consists of additional GV components. Disassembly of the GV is as follows:

a. Globe Valve.

NOTE

Refer to the paragraph covering the manifold for a particular GV should removal of the body be required.

[1] Remove handwheel nut (1), lock washer (2), and handwheel (3).

[2] Open valve and remove the bonnet nut (4). Remove the stem/bonnet assembly (10).

[3] Loosen lock nut (6) and remove packing nut (5), packing gland (7), and lock nut (6).

[4] Remove the stem (8) from the bonnet (10).

[5] Remove packing (9) from the bonnet (10).

[6] Remove the lock nut retainer (11).

[7] Remove disc lock nut (12) and remove stem (8) from the disc assembly.

[8] Remove the horseshoe ring (13).

[9] Remove nut (15), lock washer (16), disc retainer (17), disc insert (18) from disc holder (14).

NOTE

The 1/4 inch globe valve does not have a seat ring.

[10] Tag and store all removed parts until reassembly.

b. Disc Assembly.

[1] Refer to 3-2.2.8, a, step 2.

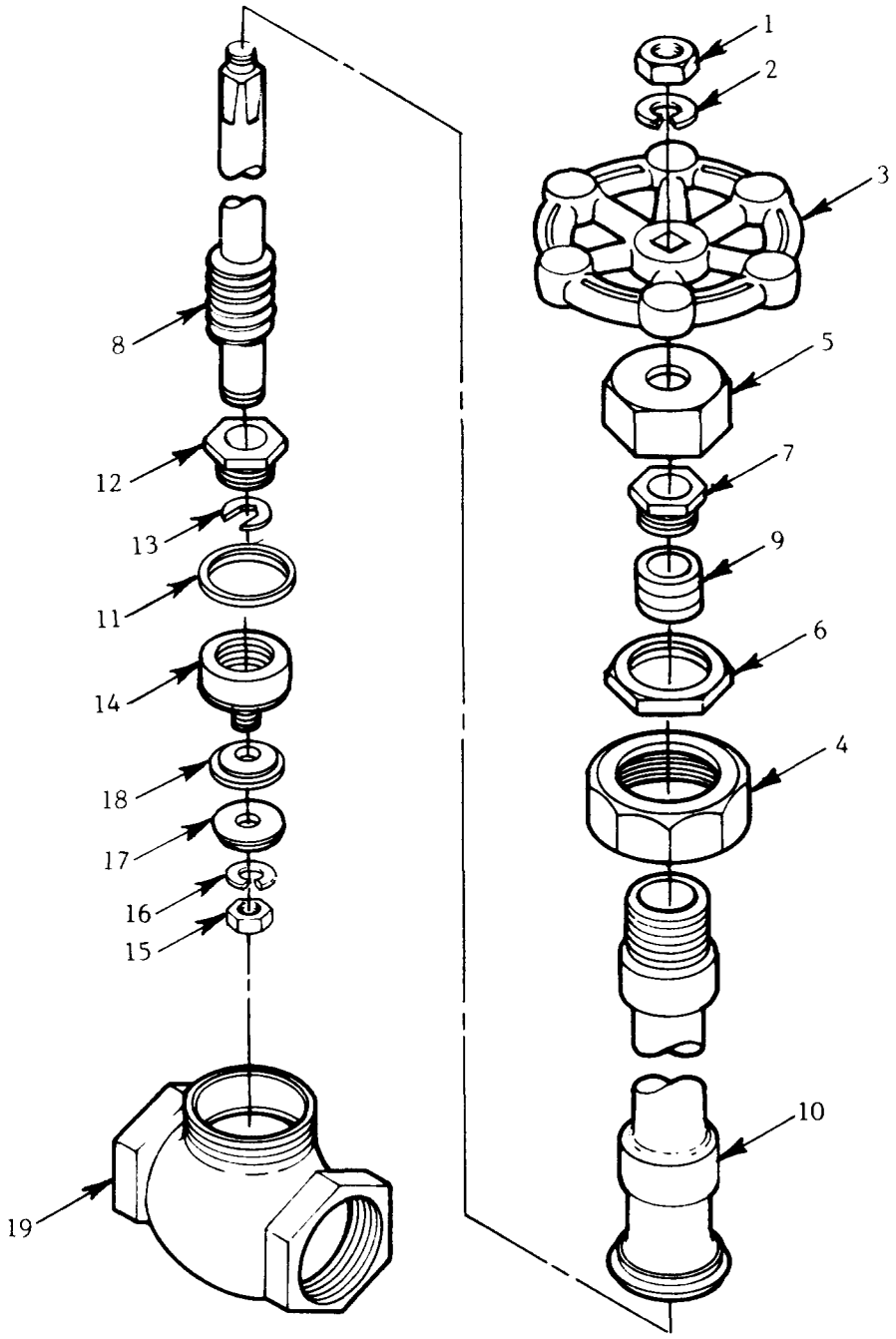
[2] Refer to 3-2.2.8, a, step 9.

3-2.2.9 Vacuum Sensor (VS) and Vacuum Indicator Shutoff Valve (V-2) Removal and Disassembly (Figure 3-9). The VS and V-2 consists of a valve and sensor. The sensor will allow attachment of a Vacuum Gage which can determine the annulus vacuum level (Refer to Figure 2-1 and Table 2-1 of the Operation and Maintenance Instructions, TO 37C2-8-29-1). Removal is as follows:

a. Vacuum Sensor and Shutoff Valve.

NOTE

DO NOT TAMPER WITH V-2 OR THE VACUUM SENSOR. ACCIDENTAL OPERATION, DISASSEMBLY, OR REMOVAL COULD DELAY A MISSION. Instructions are included only to offer a means of repair in case of damage.



1. HANDWHEEL NUT	6. LOCK NUT	11. LOCK NUT RETAINER	16. LOCK WASHER
2. LOCK WASHER	7. PACKING GLAND	12. DISC LOCK NUT	17. DISC RETAINER
3. HANDWHEEL	8. STEM	13. HORSESHOE RING	18. DISC INSERT
4. BONNET NUT	9. PACKING	14. DISC HOLDER	19. BODY
5. PACKING NUT	10. BONNET	15. DISC NUT	

NOTE: Globe valve components are the same for all valves except the 1/4 inch globe valve which does not have a seat ring.

Figure 3-8. Globe Valve and Components.

[1] With V-2 CLOSED remove VS (1).

NOTE

The vacuum indicator shutoff valve (V-2) must not be removed from the Tank unless the annular space has been filled with dry nitrogen gas (See Section V).

[2] Remove V-2 (2). Remove any traces of old vacuum sealing compound to prevent any from entering the Tank when it is evacuated. Make sure the Tank fitting is covered at all times when V-2 has been removed to prevent moisture or dust from entering the annular space.

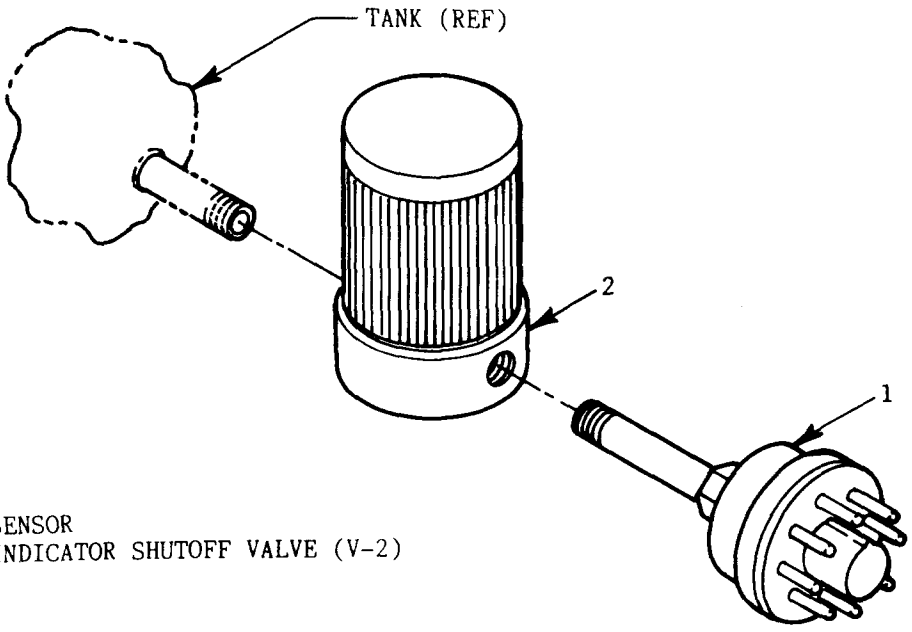
[3] Tag and store all removed parts until reassembly.

3-2.2.10 Vacuum Line Shutoff Valve (V-1) Assembly Removal and Disassembly (Figure 3-10). The V-1 assembly consists of a shutoff valve, plug, vacuum fitting flange, and associated hardware. Removal is as follows:

a. Vacuum Line Shutoff Valve.

NOTE

Do not attempt repairs until the annular space has been filled with dry nitrogen gas (Refer to Section V).



1. VACUUM SENSOR
2. VACUUM INDICATOR SHUTOFF VALVE (V-2)

Figure 3-9. Vacuum Sensor and Vacuum Indicator Shutoff Valve.

[1] Remove the plug (1) and the gasket (2).

[2] Remove nuts (3), lock washers (4), flat washers (5), bolts (6), and flat washers (7).

[3] Remove the vacuum fitting flange (8) and gasket (9).

[4] Remove nuts (10), lock washers (11), flat washers (12), and V-1 (13).

[5] Remove gasket (14) and studs (15).

[6] Remove nuts (16), lock washers (17), flat washers (18), bolts (19), flat washers (20), flange (21), and gasket (22).

NOTE

The Tank flange is welded to the outer shell. If the flange is damaged suspect that the annular space is contaminated. Field repair of the flange is not recommended.

[7] Tag and store all removed parts until assembly.

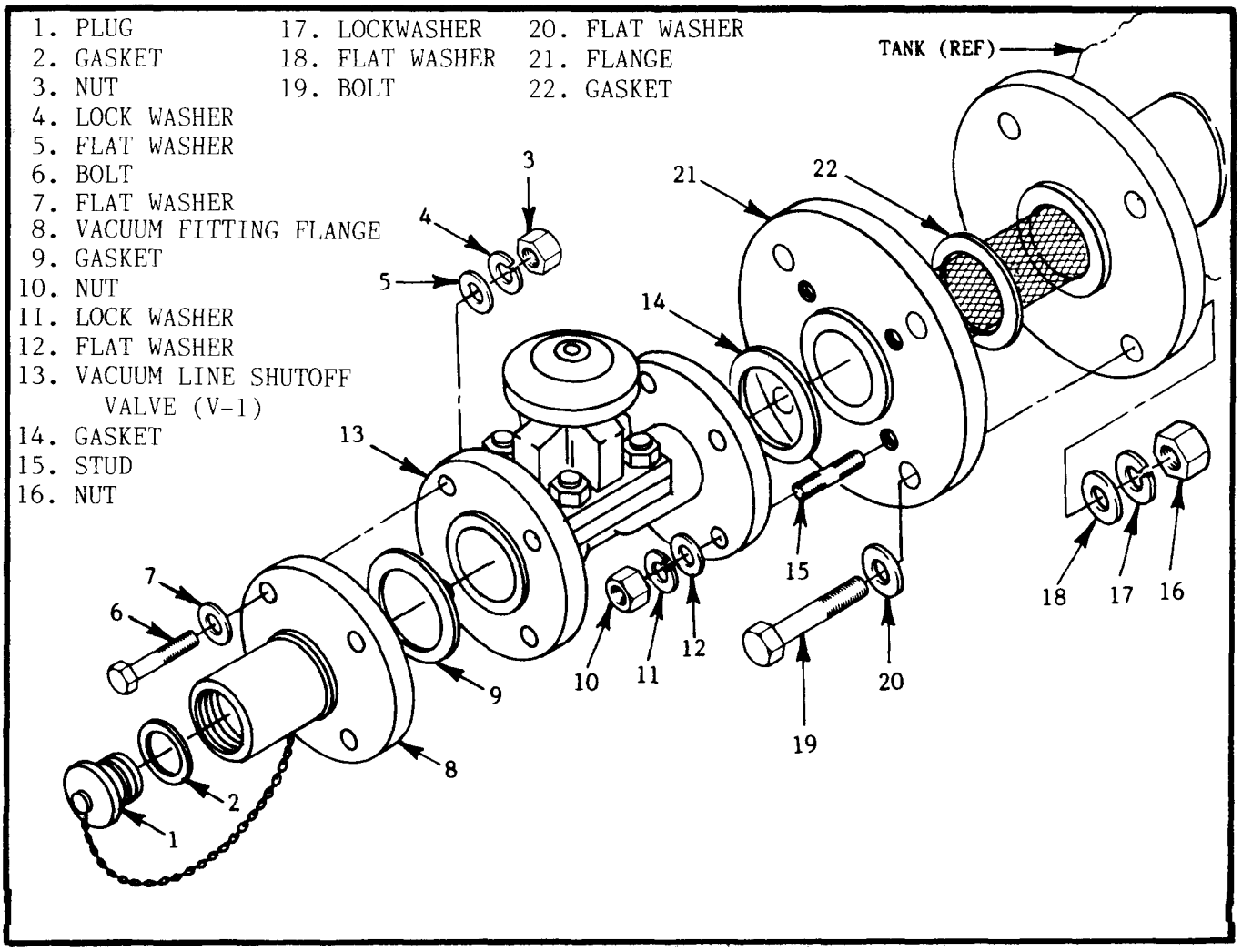


Figure 3-10. Vacuum Line Shutoff Valve.

SECTION IV
CLEANING

4-1 GENERAL.

4-1.1 Scope. This section contains special procedural instructions for the cleaning of the Tank, its subassemblies, and components. Procedures are presented for parts as they were removed following the instructions in Section III.

4-1.2 Precautions. Cleanliness and handling procedures shall be in accordance with those outlined in Section IV. Personnel shall use gloves and face shields when using solvents. Components which will come in contact with liquid product shall be plugged and bagged after cleaning. These parts shall remain plugged and bagged until reassembly is required. A review of the following precautions is recommended before cleaning is attempted.

a. Provide adequate ventilation when using cleaning solvents trichlorotrifluoroethane MIL-C-81302, (Type I). Avoid prolonged breathing of vapors and skin contact. Use protective equipment. Keep solvents away from any type of spark or flame.

b. Never use petroleum based or other flammable solvents to clean any surface or part of the Tank. A hazardous condition could result.

c. Never use shop compressed air to dry cleaned parts as it may contain hydrocarbons.

d. Overexposure to ultra-violet light can result in conjunctivitis and possible skin burns. Arrange the ultra-violet lamp so that viewing personnel will not look directly at the lamp.

4-1.3 Procedures. After Tank disassembly integral parts of the assembly and critical surfaces shall be cleaned following this procedure prior to reassembly. (Refer to MIL-STD-1359A, Cleaning methods and procedures for breathing oxygen equipment, for additional information).

a. Degrease in Cleaning Compound, Solvent, trichlorotrifluoroethane, MIL-C-81302, Type I, vapor depreaser, or submerge all parts, except the pressure gauge and O-rings, in cleaning solvent.

b. Thoroughly agitate all components to clean all surfaces; then thoroughly drain all cleaning solvent from components.

c. Ultrasonic cleaning with trichlorotrifluoroethane solvent is acceptable as applicable.

d. Purge and blow dry components with oil-free gaseous nitrogen, specification BB-N-411, Type I, Grade B, Class 1.

e. Inspect all parts under incadescent and ultraviolet lights to determine if parts are clean. Any evidence of fluorescence will require re-cleaning and ultraviolet light inspection.

f. Clean pressure gauges in accordance with T.O.37C11-1-1.

g. Clean the external surfaces of the Tank and inside the control housing with mild detergent and warm water. Do not use extremely hot water or steam.

4-2 PURGING.

4-2.1 Purpose. Purging is the process of forcing heated air through the drained Tank. Purging causes residual LOX and contaminants to be converted to a gaseous state and be expelled from the Tank. Contaminants such as moisture and carbon dioxide may be present in a solidified state along with the product at cold temperatures. These contaminants tend to settle within the Tank sump. Their concentration increases with Tank usage. Laboratory or ordor test determine when contaminants have reached an undesirable level requiring draining and purging the Tank.

4-2.2 Frequency. LOX Tanks shall be drained and purged whenever impurities exceed the use limits. These limits are established in T.O. 43B6-1-1 or T.O. 42B7-3--1-1. These T.O.s specify that whenever contamination is suspected, a sample of the product shall be sent to a designated laboratory for testing. Liquid Oxygen/ Nitrogen Sampler Model FSC2001 or equivalent is required for this purpose. Analysis of the results of the test shall be used by the Base Fuels Officer to determine if purging is required. When contamination is authenticated the source tank shall be purged. This ensures complete disposal of contaminants.

NOTE

All necessary repairs needed by the Tank should be accomplished when empty. Certain repairs require purging before and after the repairs are accomplished. Annular space evacuation (vacuum pumpout) should be accomplished during the purging process. If it is not feasible to purge and pump at the same time, the the vacuum pumping should be accomplished after the purge, while the inner tank is still hot.

4-2.3 Procedures. Purging procedures shall be accomplished according to the following (See Figure 3-1):

a. Ensure that the Tank does not contain product. Reference T.O.37C2-8-29-1 for draining procedures.

b. Remove filters and open level indicator isolation valves (V10 and V11), equalizer valve (V-12), and disconnect line tubes to the liquid level indicator (LL-1).

NOTE

The GSU-62/M Purging Unit or equivalent is required to purge LOX Tanks.

c. Position GSU-62/M purging unit next to the Tank vent line. Connect the purging unit to a source of 220/440-Volt, 3 phase, 60 Cycle AC power outlet.

d. Connect the appropriate purging unit adapter to the Tank vent line.

e. Connect the purging unit discharge hose to the Tank vent line. Attach the temperature gauge to the fill/drain line (FDL) outlet.

f. Fully open the vent valve and the FDL shutoff valve.

CAUTION

Do not allow the temperature of the air exiting the Tank to exceed 220° F to prevent possible damage to the Tank.

g. Start and operate the purging unit following instructions given in T.O. 36G2-3-1. Operate the purging unit and monitor the temperature gauge at the FDL outlet until the gauge indicates 220° F. This temperature can be maintained by cycling the purging unit heater switch OFF and ON as necessary.

WARNING

All piping and valves on the Tank will become HOT. Contact with the piping or valve will result in burns.

h. Alternately open and close all of the valves to ensure that hot air flows through the piping and valves.

i. Continue to pruge with the FDL outlet temperature at 220° F for three (3) hours.

j. When the purging time has expired, turn off the purging unit heater switch. Continue air flow into the inner shell until the FDL outlet temperature has cooled to 150° F. This will prevent cooling gases from later causing a vacuum to occur in the inner shell and drawing atmospheric air and moisture into the inner shell if a valve is opened.

k. Close all valves. Turn off and disconnect the purging unit and adapters from the Tank. Reposition the purging unit away from the area.

l. Install clean filters (F1 and F2).

m. Reconnect liquid level indicator (LL-1) lines.

CAUTION

To minimize thermal shock to the inner shell after purging a 24 hour waiting period should be initiated to allow the inner shell to cool before servicing. This waiting period will be adhered to if operational requirements permit. Upon initial servicing of the Tank service pressure should not exceed 10 psig. This will apply regardless of whether the Tank was or was not allowed to cool. This action will help lengthen the service life of the inner shell.

n. Service the Tank according to T.O. 37C2-8-29-1, Section IV, paragraph 4-5.1.

SECTION V
INSPECTION, REPAIR, AND REPLACEMENT

5-1 GENERAL.

5-1.1 Scope. This section outlines the necessary instructions for the inspection, repair, and replacement of components on the Tank. Directions for breaking the vacuum, evacuation of the annular space between the inner and outer shells, leak detection, and painting the Tank are also provided.

5-2 SPECIAL TOOLS AND TEST EQUIPMENT.

5-2.1 The special tools and test equipment required for the performance of the tasks and procedures described in this section are listed in Table 2-1.

5-3 SPECIAL MATERIALS.

5-3.1 The special materials required to perform the procedures outlined in this section are listed in Table 2-2.

5-4 RELATED PUBLICATIONS.

5-4.1 Related publications containing procedures for leak detection, valve repairs, instrument repairs, cleaning methods, packing or seal replacement, liquid oxygen compatible materials, safety requirements, and other types of data are referenced in Table 1-2.

5-5 INSPECTION.

5-5.1 General Inspection. Periodic inspections are performed in accordance with T.O.37C2-8-1-116-WC-1, Periodic Inspection Work Cards. Operation and maintenance personnel must be aware of discrepancies. The performance of an informal inspection on a monthly basis is highly recommended. During these general inspections check the following:

a. Check the control housing and panels for dents, missing hardware (e.g. nuts, bolts, etc.). Particular attention must be given to scrapes, missing paint, and other damage.

b. Check the indicators for cracked or broken glass, damaged pointers, damaged couplings or mountings, and moisture in indicators.

c. Check all valves for general condition, missing parts, signs of leakage, smooth operation, and positive seating. DO NOT CHECK THE VACUUM INDICATOR SHUTOFF VALVE (V-2) OR VACUUM LINE SHUTOFF VALVE (V-1). Any frosting on a valve or piping is an indication of a possible leak.

d. Check all tubing for looseness, bending, dents, or other damage.

e. Check all Tank markings, decals, tags, and panels. Examine for legibility, scratches, looseness, and other damage. Damaged decals should be replaced.

f. Check the exterior of the Tank for chipped paint, dents, and deformation. Pay particular attention to areas around the forklift tubes and the hoisting/tiedown rings.

g. Check the service hose and its flexible windings for excessive wear. Inspect fittings for thread and gasket (O-ring) wear or physical damage.

h. Check the vapor vent line for obstructions (e.g. plugs, caps, bird nest) if there is product in the Tank. If the Tank is in dry storage a polyethylene bag is permitted for dust and moisture.

i. Inspect the fill/drain coupling assembly for damaged or missing dust cap, gasket, or safety chain. Pay particular attention to coupling seat threads for possible damage.

j. Check the general condition of all assemblies. Inspect for loose or missing hardware. Make sure that all flange bolts and fittings are tight.

k. Inspect for general cleanness. If there is any doubt about hydrocarbon contamination around fittings, evidence of corrision, metal chips, grease, paint, preservatives, or foreign matter conduct an ultra-violet light inspection. This is especially important if the product will come in direct contact with these components. Evidence of contamination or foreign matter will indicate that cleaning is required (See Section IV) followed by an ultra-violet light inspection.

5-5.2 Periodic Inspection. Complete periodic inspections are performed in accordance with and at the intervals indicated by T.O.37C2-8-1-116WC-1, Periodic Inspection Work Cards.

5-5.3 Cleanness Inspection. Cleanliness must become an established habit for all personnel associated with the operation and maintenance of the Tank. The exterior and interior of the unit must meet established criteria for cleanness which is designed to protect the Tank, the equipment is services, and the personnel who operate and maintain it. Any discrepancies must be noted and corrected at once. Inspections are as follows:

a. Exterior inspection. Make sure that the Tank exterior is free of contamination by performing the following steps:

[1] Visually inspect for evidence of oils, greases, metal chips, and scaling.

[2] Using ultra-violet light, check ports, couplings, vapor vents, around service and fill piping, and all of the surrounding areas for evidence of hydrocarbons. Clean any fluorescent areas and remove any fluorescent particles.

b. Interior inspection. Perform interior cleanness inspections only after major overhauls, when contamination is suspected, and before a Tank is placed into service after long term storage. DO NOT PERFORM THE INTERIOR CLEANNESS TEST UNNECESSARILY as it involves filling the Tank 90% full of liquid nitrogen. Conduct the test as follows:

[1] Fill the Tank 90% to its designed capacity with pre-filtered liquid nitrogen. Accomplish the filling through the fill/drain coupling.

[2] Allow the Tank to stablize for a minimum of two (2) hours undisturbed.

[3] Obtain a Millipore membrane filter, weigh it, record the weight, and place the filter in a Millipore filter holder (See Table 1-2).

[4] Remove the protective cap from the fill/drain line and attach the filter holder in its place.

[5] Using a suitable dewar to receive the liquid nitrogen discharged through the filter holder, open the fill/drain line shutoff valve (V-5) and allow at least one (1) liter of product to pass through the line and filter.

[6] Detach the filter holder and remove the filter element. Dry the filter thoroughly. Examine it for particulate matter, weigh it for total solids, and visually examine it with a calibrated loupe.

(a) No total solid with a dimension greater than 6000 microns will be allowed.

(b) No fibrous particle with a length greater than 6000 microns will be allowed.

(c) No more than 25 milligrams of both solid and fibrous particles will be allowed.

[7] If the total material, solid or fibrous, exceeds the above specified requirements, the remaining liquid will be discharged. Discharge is made through the fill/drain line. The Tank is flushed with liquid nitrogen until the total amounts of foreign material fall within the above outlined criteria.

5-6 REPAIR AND REPLACEMENT.

5-6.1 General. Most repairs consist of removal and replacement of worn or damaged parts. These repairs are determined by visual inspection. Special instructions are presented in the following paragraphs for individual components. Some inspection notes are included with the instructions to clarify the need or facilitate the replacement procedures. Replace all items determined by inspection to be unserviceable. The following rules may be followed:

a. Threaded Components. If threads are nicked, but not deformed, they may be re-threaded using suitable taps and dies. Small nicks may be chased with small file.

b. Nuts. File deformed or nicked wrench flats to proper contours if the nut itself is not deformed.

c. Corrosion. Remove corrosion by sanding lightly with a light grade of sandpaper or emery cloth.

d. Gaskets and Packings (O-rings). Replace all damaged and worn gaskets and packings exposed during disassembly. Certain packings must be replaced on reassembly (as noted in the disassembly and assembly procedures).

e. Fasteners. Replace nuts, nutplates, screws, bolts and other threaded fasteners if threads and wrench flats are not repairable. Replace missing or damaged rivets.

f. Flared Tubes and Flared Tube Fittings. Flared tube assemblies, tubes, and fittings should be replaced only if repair is impossible. Be sure to inspect flared surfaces for cracks and deformation. Check compression nuts and sleeves.

NOTE

Scratched flared-tube surfaces and stainless steel fitting surfaces may often be repaired by sanding lightly with a fine abrasive material.

g. Labels, Decals, and Nameplates. Labels, decals, and nameplates which have become illegible or partially defaced must be replaced. Check nameplate attachments. Replace loose or deformed rivets.

h. Globe Valves. The servicing line shutoff valve (V-3), servicing line drain valve (V-4), fill/drain line shutoff valve (V-5), fill/drain line drain valve (V-6), pressure buildup control valve (V-7), vapor vent line shutoff valve (V-8), and the full trycock valve (V-9) should be inspected. Check for deformed packings, worn discs, nicked valve disc assemblies.

[1] Repair of these valves should be limited to the replacement of worn or damaged parts. Internal leakage through a valve is usually the result of a faulty sealing disc or damaged seat ring. External leakage at the top of the valve bonnet is usually the result of a damaged or worn packing.

[2] If the valve leaks externally at the top of the bonnet try and tighten the packing nut. If leakage is at the bottom of the bonnet try and tighten the bonnet nut.

[3] Globe valves are threaded on the manifold sections using anti-seize tape. The globe valves can be rebuilt without disassembling the body. If the body is damage or leaking at the manifold threads then removal of the body will be required. Replacement will depend upon the repairability of the body.

i. Instrumentation Valves. The liquid and vapor level indicator isolation valves (V-10 and V-11) and the level indicator equalizer valve (V-12) are more practically replaced than repaired. Dispose of the damaged valves through the usual channels.

CAUTION

DO NOT OPERATE, REMOVE, OR ATTEMPT TO REPAIR the vacuum indicatior shutoff valve (V-2) or the vacuum line shutoff valve (V-1) during routine inspections.

j. Vacuum Valves. The vacuum indicator valve (V-2) should only be opened during vacuum efficiency tests. The vacuum line shutoff valve (V-1) should only be opened to evacuate the annular space. If these valves are determined to be defective replacement should be with valves of know integrity. Removal should only take place after breaking the vacuum and replacing it with nitrogen gas.

k. Tank Pressure Relief Valve. The Tank pressure relief valve (RV-3) is a sealed (ASME Code) unit. Attempt no repairs or adjustments. Indications of leakage is constant venting, frosted tubing, or the inability to achieve pressure buildup for product transfer. If leakage is suspected replace the valve and dispose of it through normal channels. A method for testing the valve is outlined in Section VII.

l. Fill/Drain and Service Pressure Relief Valves. The fill/drain line pressure relief valve (RV-2) and the servicing line pressure relief valve (RV-1) are safety devices to relieve pressure trapped between shutoff points in the respective lines. Repair of these valves should be limited to disassembly and cleaning. Replace the valve if the seal is permanently deformed, cracked, damaged, or the mating surfaces are scored or pitted. Testing procedures for the determination of relief pressure appears in Section VII.

m. Safety Heads. Failure of the inner shell safety head (SD-1) is usually indicated by a failure to achieve pressure buildup for product transfer, frosted vent lines, and constant venting not associated with the inner shell pressure relief valve (RV-3) or the vapor vent line shutoff valve (V-8). Replacement of the safety head should be with a new unit.

n. Fill/Drain and Service Line Filters. Filters should be replaced whenever they appear to restrict the flow of product. Procedures for the removal and replacement of the line filters appear in Section V of the Operation and Maintenance Instructions, T.O.37C2-8-29-1. The arrow on the filters should point in the direction of the line flow. The service line flow is away from the Tank and the fill/drain flow is towards the Tank.

o. Indicators. Defective indicators are located in the control panel. Indicators are generally repaired when the Tank has been drained and purged. The Tank liquid level indicator can be changed by isolating it using the level indicator isolation valves (Vapor V-10 and Liquid V-11). Calibration information for the Tank indicators is found in T.O.33K-1-100. The local Precision Management Equipment Laboratory (PMEL) is

responsible for calibration. Consult with the cognizant PMEL office on forwarding an indicator for calibration. Follow their instructions for handling and packaging.

5-7 WELDING.

WARNING

- Welding/cutting operations produce heat, metal fumes, injurious radiation, metal slag, and airborne particles. Approved welder's safety equipment will be used. Ventilation requirements will be determined by the Base Bioenviromental Engineer.
- Never look directly at the arc during welding operations without proper eye protection.

5-7.1 All welding on the Tank shall be accomplished by certified welder in accordance with MIL-STD-1595, using standard welding practices and procedures (Refer to T.O.00-25-224).

a. Tank Outer Shell. Welding on the Tank's outer shell is not recommended at the base level. The method and information presented here is to prevent work stoppage or mission delay.

CAUTION

DO NOT ATTEMPT TO WELD ON THE OUTER SHELL, PIPING, OR FRAME UNTIL THE TANK HAS BEEN DRAINED AND PURGED. The annular space must be broken and replaced by a nitrogen atmosphere.

[1] All welding on the Tank's outer shell shall be performed by a welder certified in accordance with MIL-STD-1595, using heliarc welding only (Refer to T.O.00-25-224).

b. Tank Frame, Saddle, and Skid. Welding on frame members may be accomplished by an electrical method at any level of maintenance where qualified personnel and equipment are available.

5-8 BRAZING.

WARNING

- Brazing operations are hazardous to the eyes. Welding goggles with proper shade lenses are required. Ventilation requirements will be determined by the Base Enviromental Engineer.
- Brazing must never be attempted near Teflon components. They will deteriorate at temperatures of 500° F and emit poisonous gas. Make sure that Teflon packings and rings are removed from valves, and that no Teflon anti-seize tape remains on the threaded connections before brazing in the vicinity.

5-8.1 The pipe plugs at the top of the Tank are the only brazed components on this Tank. This plug is where the powdered insulation is placed within the annular space. It is a threaded component but requires brazing to prevent vacuum leakage. All brazed connections must be joined using an alloy rod or wire containing a minimum of 50% silver. Brazing must also be in conformance with Federal Specification QQ-B-654A and a flux conforming with Federal Specification O-F-499c.

5-9 BREAKING THE ANNULUS VACUUM.

5-9.1 Repairs (See Figure 3-10). When repairs to the outer shell or piping must be performed which will affect the status of the annular space the vacuum must be replaced with a nitrogen atmosphere. NO POSITIVE PRESSURE MAY BE APPLIED and the nitrogen gas must be drawn into the space according to the following procedures:

a. The vacuum line shutoff valve (V-1) is located at the top rear of the outer shell on the Tank.

b. Remove the protective cap (1) and gasket (2) on V-1 (13).

c. Connect a source of low-pressure nitrogen gas (Specification BB-N-411, Grade A, Type 1) to the flange (8) orifice. Regulate the nitrogen source to 2 to 3 psig.

d. Open the nitrogen source service valve. Slowly open V-1 and allow the nitrogen to be drawn into the annular space.

e. When the nitrogen flow stops close the nitrogen source valve and V-1.

f. Disconnect the nitrogen source from V-1.

g. Reassemble the gasket and protective cap (1).

5-10 TANK ANNULUS EVACUATION.

5-10.1 Evacuation (See Figure 3-10). Deterioration of the annulus vacuum over period of time is normal. The periodic inspection record will give an indication of the annulus condition. A warm Tank will have a slightly higher pressure indication in comparison to a cold Tank. This condition does not necessarily indicate a vacuum loss but a sudden loss may indicate leakage. A thorough and complete inspection will probably determine the cause.

CAUTION

Do not attempt to evacuate the Tank annular space until the cause of the vacuum loss has been determined and if necessary repaired.

a. Determine the Tank annulus vacuum level following the procedure referenced in Section VII, Testing. After the test close the vacuum indicator shutoff valve (V-2) (3, Figure 3-9).

b. The vacuum line shutoff valve (V-1) is located at the top rear of the outer shell on the Tank.

c. Remove the protective cap (1) and gasket (2) on V-1 (15).

d. Connect a hose from the vacuum pump to the flange (8) orifice.

e. Start the vacuum pump and read the vacuum level at the pump. It must be below 5 microns before the pump valve is opened. Record the vacuum level.

CAUTION

TAKE CARE TO AVOID ACCIDENTAL SHUT-OFF THE VACUUM PUMP DURING EVACUATION. Vacuum loss due to oil ingestion will be immediate and the TANK MUST BE CONDEMNED AS UNSERVICEABLE.

f. Slowly open the pump valve to the vacuum hose and allow the pump to evacuate the hose for approximately ten (10) minutes. Record the vacuum level in the hose. It should not be more than three (3) microns greater than the level recorded at the pump.

g. Slowly open V-1. There may be a rise in the hose vacuum level which is normal.

h. After four (4) hours of pumping there should be a large drop in the hose vacuum which will indicate there are no leaks in the system.

i. Observe and record the vacuum level indicated by a portable gage attached to the vacuum sensor inside the control housing. V-2 must be open to obtain this reading. After reading close V-2.

j. Continue to pump until the desired level is indicated on the portable gage (15 microns, warm; 1 micron, cold).

k. When the annulus is evacuated to the desired level close V-1. Turn off the vacuum pump and open the vacuum hose bleed valve so it can stabilize.

l. Open V-2 and determine the vacuum level using the portable gage connected to the vacuum sensor. Record the vacuum level with the annular space. Monitor the indicator for two (2) hours. Watch for any rise in pressure which would indicate a leak.

m. Disconnect the vacuum hose from the flange (8) and inspect for any evidence of pump lubricant which may have been drawn into the area by the vacuum. If no contamination is present reassemble the gasket (2) and protective cap (1). If there is evidence of contamination clean the affected area with freon (See Table 2-1) and test for vacuum loss (Refer to Section VII). Vacuum loss will be immediate if oil has been ingested and the Tank will be unserviceable.

CAUTION

To avoid vacuum loss make sure that the vacuum gage valve is closed tightly.

n. When the vacuum level has stabilized and is within the appropriate limits close V-2. Set the portable vacuum gage switch to off. Disconnect the vacuum gage from the vacuum sensor.

5-11 PAINTING AND MARKING.

5-11.1 Repair any damage to painted surfaces in accordance with T.O. 35-1-3, MIL-STD-808 (Refer to Table 1-2), and SA/ALC Drawing 7547352, Requirements for finishes, Protective and Codes for San Antonio ALC Ground and Ground Support Equipment. These are for Type 1 finishes giving protection from climatic elements. Application shall be made in accordance with the above documents and as follows:

a. Insure that all open ports on the Tank are covered with polyethylene bags or appropriate plugs after the Tank has been drained and purged.

b. Inspect surfaces to be painted with ultraviolet light for evidence of hydrocarbon contamination (hydrocarbons will be fluorescence). If hydrocarbon contaminants are present then degrease with isopropyl alcohol, TT-I-735 and re-inspect.

c. The basic painting materials are:

[1] Epoxy Primer, yellow, in accordance with MIL-P-23377, Type I, Class 2, or Water Borne Epoxy Primer, yellow, in accordance with MIL-P-85582, Type I, Class 2.

[2] For Tanks in liquid oxygen service the paint finish shall be polyurethane in accordance with MIL-C-83286 or MIL-C-85285. The color shall be gloss white, No. 17875 as specified in FED-STD-595A.

d. Unpainted Areas. Do not attempt to paint copper line tubing and stainless steel manifolds.

e. Marking. External markings shall be in accordance with MIL-STD-130.

SECTION VI
ASSEMBLY

6-1 GENERAL.

6-1.1 Scope. This section contains assembly instructions for the Storage Tank, Liquid Oxygen, Type TMU-7A/E, 2000 Gallon capacity. Testing instructions are outlined in Section VII, Testing and will be referenced when applicable throughout the text.

6-2 PRECAUTIONS.

6-2.1 Cleanness. Cleanness is essential for all components in contact with the product. Spontaneous combustion may occur if the product contacts incompatible cleaning residues or hydrocarbon substances.

a. Enviromental Concerns. The Tank should be assembled in an approved clean area. Parts, tools, and the general enviroment shall be maintained with a high degree of cleanliness at all times. Any component which contacts the product shall be assembled in a controlled enviroment and the utmost care shall be taken to prevent contamination of the components.

b. Protection of Components. All bagged and plugged components shall remain so until ready for assembly. Assembled components shall be sealed or bagged until ready for assembly. Components which become contaminated during calibration or component testing shall be recleaned before installation on the Tank.

6-2.2 Prevention of Damage. Exercise care at all times during Tank assembly to avoid damage or distortion of component. Only tools most suited for a particular application may be used. A suitable fixture, vise, or other type support shall be used to support all applicable components during assembly.

6-3 GENERAL INSTRUCTIONS.

a. Identification Tags. All temporary identification tags shall be removed during installation of the components.

b. Assembly of Threaded Joints and Fittings. Thread sealant (anti-seize) tape conforming to Specification MIL-T-27730 shall be applied to the male threads of all pipe threaded fittings before assembly (See Table 2-2). The exception is for threaded fittings for the vacuum, indicator, and small tubing connections. These instances will be noted as appropriate in the text. The tape shall be applied starting with the third thread from the end of the fitting. This prevents releasing tape particles into the system. Tape will also be wrapped in the direction of the threads.

c. Lubrication. No lubrication shall be applied to components during installation. The exception will be a small amount of oxygen compatible stopcock grease, KEL-F-90, may be applied to the threads of the stainless steel flange bolts (23, Figure 3-3, 24, Figure 3-4 and 37, Figure 3-6) to prevent galling (Refer to Table 2-2).

6-4 ASSEMBLY PROCEDURES.

6-4.1 Order of Assembly. The order of assembly for components on the Tank is generally in the reverse order of disassembly, Instructions are first given for complete assembly followed by component replacement assembly. The steps for component replacement reference steps in the complete assembly. Reference to illustrations are figures in Section III in this manual. Torque values for threaded components can be found in Table 8-1, Table of Limits, Section VIII.

6-4.1.1 Vacuum Line Shutoff Valve (V-1) Assembly (Figure 3-10). Installation of V-1 components should not be attempted unless the annular space has been purged and filled with dry nitrogen gas (Refer to Section V).

a. Vacuum Shutoff Valve.

[1] Supporting V-1 (13), place the gasket (14) between the mating flanges. Install flat washers (12), lock washers (11), and nuts (10). Torque to meet the requirements of the Table of Limits, Section VIII.

[2] Supporting vacuum fitting flange (8), place gasket (9) between the mating flanges. Install bolts (6) into flat washers (7). Then insert bolts (6) into flange holes and install flat washers (5), lock washers (6), and nuts (3). Torque to meet requirements of the Table of Limits, Section VIII.

[3] Install gasket (2) on plug (1). Install (1) into vacuum fitting flange (8) orifice.

6-4.1.2 Vacuum Sensor (VS) and Vacuum Indicator Shutoff Valve (V-2) Assembly (Figure 3-9). Installation of the VS and V-2 should not be attempted unless the annular space has been purged and filled with dry nitrogen gas (Refer to Section V). These instructions are included only for replacement of parts in the event of a failure of the VS or V-2.

a. Vacuum Sensor and Shutoff Valve.

[1] Apply vacuum sealing compound (Refer to Table 2-2) to the male threads of the vacuum piping. Begin one (1) thread away from the end.

CAUTION

Do not use any tool to operate the vacuum indicator shutoff valve. Over-tightening the valve knob will cause damage.

[2] Install V-2 (2) on the vacuum piping, tighten by turning V-2 clockwise but do not over torque. The compound will provide sufficient sealing.

[3] Apply vacuum sealing compound to the male threads of the VS. Begin one (1) thread from the end.

[4] Install the VS (1) but do not over torque. Make sure V-2 is CLOSED.

6-4.1.3 Globe Valve (GV) Assembly (Figure 3-8). GV assembly is as follows:

a. Globe Valve.

NOTE

GV bodies must be assembled with their respective manifolds. Reserve assembly of the stem/bonnet assembly into the GV body until the bodies are installed in the manifolds All globe valves must be in the full open position before attempting assembly into the GV body.

[1] Install disc insert (18), disc retainer (17), lock washer (16), and nut (15) onto disc holder (14).

[2] Slide disc lock nut (12) onto stem (8) and install horseshoe ring (13) on (8). Install (12) into disc holder (14). Torque (12 and 15) to meet requirements of the Table of Limits, Section VIII.

[3] Insert the stem (8) into the bonnet (10).

[4] Slide bonnet nut (4) on bonnet (10). Install packing (9), lock nut (6), packing gland (7), and packing nut (5). Torque to meet requirements of the Table of Limits, Section VIII.

[5] Install the stem/bonnet assembly

into body (19). Torque to meet the requirements of the Table of Limits, Section VIII.

[6] Install handwheel (3), lock washer (2), and handwheel nut (1). Torque to meet requirements of the Table of Limits, Section VIII.

b. Disc Assembly.

[1] Refer to 6-4.1.3, a, step 1.

[2] Refer to 6-4.1.3, a, step 5.

6-4.1.4 Control Panel (CP) and Full Trycock Valve (V-9) Assembly (Figure 3-7). Assembly of V-9 and the CP is as follows:

a. Control Panel.

NOTE

When applying anti-seize tape on male threads for all components start with the third thread from the end.

[1] Install bulkhead connector (61) in the control housing backplate and panel nut (60).

[2] Install line tube (59) on the outside of the control housing.

[3] Put anti-seize tape (Refer to Table 2-2) on the male threads of pipe nipple (58). Install pipe clamp (54) top portions (55 and 56) and pipe nipple (58).

[4] Install V-9 (50) body (52) on pipe nipple (58).

CAUTION

Make sure the the full trycock valve is in its full open position before installing the stem/bonnet assembly into the valve body.

[5] Install the stem/bonnet assembly (51) into body (52).

[6] Put anti-seize tape on the NPT male threads of male connector (49). Install (49) into body (52).

[7] Install line tube (48).

[8] Install male connector (57).

[9] Put anti-seize tape on the NPT male threads of connector (47). Install male connector (47) and line tube (46).

[10] Insert the Tank liquid level indicator (LL-1) (45) into panel (8). Install lockwashers (44) and nuts (43). Torque to meet requirements of the Table of Limits, Section VIII.

NOTE

Male connectors (19 and 20) can be install in LL-1 before installing LL-1.

[11] Insert the vapor phase pressure indicator (PI-1) (42) into panel (8). Install screws (41), lock washers (40), and nuts (39).

[12] Put anti-seize tape on the NPT male threads of male connector (38) and tee (37). Install (37 and 38) into the level indicator isolation valve (liquid) (V-11) (36).

[13] Insert V-11 (36) into panel (8) and install panel nut (35), packing nut (34), and knob (33).

[14] Put anti-seize tape on the NPT male threads of elbow (32) and tee (31). Install (31 and 32) into the level indicator equalizer valve (V-12) (30).

[15] Insert V-12 (30) into panel (8) and install panel nut (29), packing nut (28), and knob (27).

[16] Put anti-seize tape on the NPT male threads of connector (26) and tee (25). Install (25 and 26) into the level indicator isolation valve (vapor) (V-10) (24).

[17] Insert V-10 (24) into panel (8) and install panel nut (23), packing nut (22), and knob (21).

[18] Put anti-seize tape on the NPT male threads of PI-1 (42). Install tee (13) onto (42).

[19] Install bulkhead connector (13) into panel (8) and install panel nut (12) and install cap (11).

[20] Install line tube (10) onto tee (14) and bulkhead connector (13).

[21] Put anti-seize tape on the NPT male threads of male connectors (19 and 20) and install (19 and 20) into LL-1 (45).

[22] Install line tube (18) onto male connector (19) and tee (37).

[23] Install line tube (16) onto male connector (20) and tee (31).

[24] Install line tube (9) onto tee (14) and tee (25).

[25] Install line tube (15) onto male connector (26) and tee (31).

[26] Install line tube (17) onto male connector (32) and tee (37).

[27] Install line tube (3) onto tee (24).

[28] Install line tube (1) onto male connector (38).

[29] Place the assembled panel on the Tank and install bolts (7), lock washers (6), and nuts (5). Torque to meet requirements of the Table of limits, Section VIII.

[30] Put anti-seize tape on the NPT male threads of connectors (2 and 4). Install connectors (2 and 4) and line tube (1) to connector (2), line tube (3) to connector (4).

[31] If any decals need to be replaced drill out old rivets. Place replacement decal on panel and in-install rivets.

b. Indicator Isolation Valve (Vapor).

[1] Refer to 6-4.1.4, a, steps 16 and 17.

c. Indicator Equalizer Valve.

[1] Refer to 6-4.1.4, a, steps 14 and 15.

d. Indicator Isolation Valve (Liquid).

[1] Refer to 6-4.1.4, a, steps 12 and 13.

e. Vapor Phase Pressure Indicator.

[1] Refer to 6-4.1.4, a, steps 11, and 18.

[2] Connect line tubes (9 and 10).

f. Liquid Level Indicator.

[1] Refer to 6-4.1.4, a, steps 10, 21, 22, and 23.

g. Full Trycock Valve.

[1] Refer to 6-4.1.4, a, steps 4, 5, 6, and 7.

6-4.1.5 Vapor Vent Manifold (VVM) Assembly (Figure 3-6). Assembly of the VVM is as follows:

NOTE

When applying anti-seize on the male threads for all components start with the third thread from the end.

[1] Supporting manifold (44) insert flange gasket (45) between mating flanges and install bolts (38), into flat washers (39) then insert (38) into flange holes and install flat washers (37), lock washers (36), and nuts (35). Torque to meet requirements of the Table of Limits, Section VIII.

[2] Install clamp (43), plate (42), and bolts (40) and torque to meet the requirements of the Table of Limits, Section VIII. Connect manifold (44) if the pressure buildup coil (PBC) is already installed. If the PBC isn't installed cap the open end of the manifold (44).

[3] Put anti-seize tape (See Table 2-2) on the male threads of the inner shell pressure relief valve (RV-3) (34) and install (34) into manifold (44).

[4] Put anti-seize tape on the male threads of the union half (30) only on the threads which install into (34) and install (30) into (34).

[5] Put anti-seize tape on the male threads of the top small horizontal line on manifold (44) and install union half (27).

[6] Put anti-seize tape on the male threads of the bottom large horizontal line on manifold (44) and install the body (33) for the vapor vent line shutoff valve (31). Install the stem/bonnet assembly (32) in (33) (Refer to globe valve assembly paragraph 6-4.1.3, a, step 5).

[7] Put anti-seize tape on the male threads of the union half (29) only on the threads which install into GV body (33). Install (29) into (33).

[8] Put anti-seize tape on the male threads of the top small horizontal line on manifold (25). Install union (4).

[9] Put anti-seize tape on the male threads of the lower small horizontal line on manifold (25). Install the adjustable pressure control valve (PC-1) (28).

[10] Put anti-seize tape on the male threads of union (3) and install (3) into (28).

[11] Supporting manifold (25) install bolts (6, 10, and 14) into pipe clamps (7, 11, and 15) fingertight.

[12] Install inner shell safety head (SD-1) (26) into union half (27).

[13] Slide manifold (25) to the left and connect unions (2, 3, 4, and 5). Do not over torque.

[14] Tighten bolts (6, 10, and 14). Torque to meet requirements of the Table of Limits, Section VIII.

[15] Before installing the vapor vent line (24) insert (24) through the vent line adapter plate (22) and gasket (23). Inserting (24) through the control housing, slide (24) to the right and connect union (1).

[16] Position the (22 and 23) next to the control housing and install bolts (20) into flat washers (21) and insert in (22). Install lock washers (19) and nuts (18). Torque to meet the requirements of the Table of Limits, Section VIII.

b. Vapor Vent Shutoff Valve.

[1] Refer to 6-4.1.5, a, steps 6 and 7.

[2] Slide manifold (25) to the left and connect unions (1, 2, 3, 4, and 5). Do not over torque.

[3] Refer to 6-4.1.5, a, step 14.

c. Pressure Control Valve.

[1] Refer to 6-4.1.5, a, step 9 and 10.

[2] Refer to 6-4.1.5, b, step 2.

[3] Refer to 6-4.1.5, a, step 14.

d. Inner Shell Safety Head.

[1] Refer to 6-4.1.5, a, step 12.

[2] Refer to 6-4.1.5, b, step 2.

[3] Refer to 6-4.1.5, a, step 14.

e. Inner Shell Pressure Relief Valve.

[1] Refer to 6-4.1.5, a, steps 3 and 4.

[2] Refer to 6-4.1.5, b, step 2.

[3] Refer to 6-4.1.5, a, step 14.

6-4.1.6 Pressure Buildup Coil (PBC) Assembly (Figure 3-5). Installation of the PBC is as follows:

a. Pressure Buildup Coil.

[1] Remove union cap (6) and cover from manifolds. Replace cap (6) on bracket (12).

[2] Carefully insert PBC (7) thru the left side door of the control housing, while preventing PBC (7) from dropping. Slowly slide PBC (7) towards the rear U-bolts (5) and insert PBC into U-bolts. Temporarily connect unions (1) and (2).

CAUTION

When mounting the pressure buildup coil do not fasten it tightly to the mounting plates. It must be secured in a manner that will allow contraction when liquid product enters the coil to prevent damage.

[3] Install left front mounting bracket (12), bolts (11), flat washers (10), and nuts (9). Install front U-bolts (5), flat washers (4), and nuts (3) and tighten unions (1 and 2). Torque to meet the requirements of the Table of Limits, Section, VIII.

NOTE

The nuts are applied by double nutting.

[4] If the plug (8) was removed at any time replace it.

6-4.1.7 Fill/Drain Line (FDL) Assembly (Figure 3-4). The FDL assembly is as follows:

a. Fill Drain Line.

NOTE

When applying anti-seize on male threads for all components start with the third thread from the the end.

[1] Supporting the flanged manifold (35) insert gasket (36) between mating flanges. Install bolts (33) into flat washers (34). Insert (33) into flange holes and install flat washers (32), lock washers (31), and nuts (30). Torque to meet the requirements of the Table of Limits, Section VIII.

[2] Put anti-seize tape on both threaded ends of flanged manifold (35). Install the appropriate globe valve bodies (25 and 29) on the cooresponding ends of (35) in relation to the sizes.

[3] Install the stem/bonnet assem-

blies (25 and 28) in their respective bodies (Refer to globe valve assembly: 6-4.1.3, a, step 5.

[4] Ensure the pressure buildup coil (7, Figure 3-5) is not installed before installing manifold (26). Put anti-seize tape on the threaded end of manifold (26) and install (26) into globe valve body (29). Connect the union end of (26) to the pressure buildup coil when installed (Refer to 6-4.1.6).

[5] Ensure pressure buildup coil (7, Figure 3-5) is not installed before installing manifold elbow (22). Put anti-seize tape of the male threads of the manifold elbow (22) and install (22) into globe valve body (24).

[6] Install the FDL filter (21) making sure the arrow is pointing inward towards the Tank.

[7] Put anti-seize tape on all male threads on the drain/relief manifold (20) and install (20) in (21).

[8] Install support brace (18), bolts (17), lock washers (16), and nuts (15). Install pipe clamp (12) and bolts (11). Torque to meet requirements of the Table of Limits, Section VIII.

[9] Put anti-seize tape male threads of the pressure relief valve (RV-2) (19) and install (19) while supporting the tubing. Install body (10) of drain valve (8) on manifold (20).

[10] Install the stem/bonnet assembly (9) into the drain valve body (10) (Refer to globe valve assembly: 6-4.1.3, a, step 5).

[11] Put anti-seize tape on the male threads of connector (7) and install (7) into (10).

[12] Connect the small drain line (6) to (7).

[13] Put anti-seize tape on the drain/relief manifold (16) and install hex bushing (5) on (20).

[14] Install the LOX coupling seat (3) on hex bushing (5). Insert the gasket (4) into (3). Install dust cap (2) on (3).

b. LOX Coupling.

[1] Refer 6-4.1.7, a, step 14.

c. Bushing.

[1] Refer to 6-4.1.7, a, steps 13

d. Drain Lines.

[1] Refer to 6-4.1.7, a, step 12.

e. Drain and Relief Valves.

[1] Refer to 6-4.1.7, a, steps 9, 10, 11, and 12.

f. Pipe Clamp.

[1] Refer to 6-4.1.7, a, step 8.

g. Filter.

[1] Refer to 6-4.1.7, a, steps 5, 6, 7, 8, 10, 11, 12, 13, and 14.

h. Shutoff Valve.

[1] Refer to 6-4.1.7, a, steps 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, and 14.

i. Pressure Buildup Valve.

[1] Refer to 6-4.1.7, a, step 2.

[2] Install body (29) and stem/bonnet assembly (28) into (29). Torque to meet the requirements of the Table of Limits, Section VIII.

[3] Refer to 6-4.1.7, a, step 4.

6-4.1.8 Servicing Line (SL) Assembly (Figure 3-3). The SL assembly is as follows:

a. Servicing Line.

NOTE

When applying anit-seize tape on male threads for all components start with the third thread from the end.

[1] Supporting the flange manifold (27) insert gasket (28) between mating flanges. Install bolts (25) into flat washers (26). Insert bolts (25) into flange holes and install flat washers (24), lock washers (23) and nuts (22). Torque to meet requirements in the Table of Limits, Section VIII.

[2] Put anti-seize tape on the male threads of the flange manifold (27) and install the body (21) of globe valve (19). Install the stem/bonnet assembly (20) into (21) (Refer to globe valve assembly 6-4.1.3, a, step 5).

[3] Put anti-seize tape on the male threads of the manifold nipple (18) and install (18) into (21).

[4] Install the filter (17) on (18) making sure the arrow is pointed away from the Tank.

[5] Put anti-seize tape on the male threads of drain/relief manifold (16) and install (16) into (17).

[6] Install pipe clamp (13). Install bolts (12). Torque to meet the requirements of the Table of Limits, Section VIII.

[7] Put anti-seize tape on the male threads of pressure relief valve (RV-1) (11) and install (11) while supporting the tubing. Install body (10) of drain valve (8) on manifold (16).

[8] Install the stem/bonnet assembly (9) into the drain valve body (10) (Refer to globe valve assembly 6-4.1.3, a, step 5).

[9] Put anti-seize tape on the male threads of the drain line tee (07) which installs into (10). Install (7) into (10).

[10] Connect the short drain line to (7) and the male connector on the fill/drain line drain valve. Connect the long drain line to (7) and the male connector in the control housing wall.

[11] Install the LOX coupling seat (3) and insert the gasket (4) into (3). Install dust cap (2) on (3).

b. LOX Coupling.

[1] Refer to 6-4.1.8, a, step 11.

c. Drain Line.

[1] Refer to 6-4.1.8, a, step 10.

d. Drain and Relief Valves.

[1] Refer to 6-4.1.8, a, steps 5, 7, 8, 9 and 10.

e. Pipe Clamp.

[1] Refer to 6-4.1.8, a, step 6.

f. Filter.

[1] Refer to 6-4.1.8, a, steps 3, 4, 5, 6, 7, 8, 9, and 10.

g. Shutoff Valve.

[1] Refer to 6-4.1.8, a, steps 2, 3, 4, 5, 6, 7, 8, 9, and 10.

6-4.1.9 Servicing Hose (SH) Assembly (Figure 3-2). The SH assembly is as follows:

a. Service Hose.

NOTE

When applying anti-seize on male threads for all components start with the third thread from the end.

[1] Put anti-seize tape on the male threads of the hose nipple (8) and install (8) into the hose adaptor fitting.

[2] Insert the coupling cone (6) into coupling nut (7) and install the retaining ring (5). Once assembled install (6) on (8). Install dust cap (4) into (7).

[3] Put anti-seize tape on the male threads of the hose nipple (13) and install (13) into the hose adaptor fitting.

[4] Insert the coupling cone (11) into coupling nut (12) and install the retaining ring (10). Once assembled install (11) on (13).

[5] If the SH can be installed on the Tank install the SH on the servicing line LOX coupling (See Figure 3-3). If the SH cannot be installed at this time wrap the coupling (9) with a polyethylene bag and seal it.

b. LOX Couplings.

[1] Refer to 6-4.1.9, a, step 2.

6-4.1.10 Control Housing (CH) Assembly (Figure 3-1). CH assembly is as follows:

a. Control Housing.

[1] Place strap catch (64) on hose bracket (53) and install screws (63), lock washers (62), and nuts (61). Torque to meet the specifications of the Table of Limits, Section VIII.

[2] Place strap bracket (60) on hose bracket (53) and install bolt (59), lock washer (58), and nut (57). Insert strap (56) into (60) and install bolt (55) and nuts (54).

NOTE

When tightening nuts for the strap allow enough play so strap can move freely within bracket.

[3] Place hose bracket (53) in CH and install bolts (51) into flat washers (52) and install lock washers (50), and nuts (49). Torque to meet requirements of the Table of Limits, Section VIII.

[4] Place door latch (48) on door (46) and install rivets (47).

[5] Place hinge (45) on door (46) and install bolts (43) into flat washers (44) and install lock washers (42) and nuts (41). Torque to meet the requirements in the Table of Limits, Section VIII.

[6] Place door (46) with hinge (45) installed on CH and install bolts (43) into flat washers (44) and install lock washers (42) and nuts (41). Torque to meet the requirements of the Table of Limits, Section VIII.

[7] Place door latch plate (40) on skid and install screws (39), lock washers (38), and nuts (37). Torque to meet requirements in the Table of Limits, Section VIII.

[8] Place door holder (36) on door (11) and install screws (35), lock washers (34), and nuts (33). Repeat this procedure for door (12). Torque to meet the requirements of the Table of Limits, Section VIII.

[9] Place door lock catch (32) on the CH and install screws (30) into flat washers (31) and install lock washers (29) and nuts (28). Torque

to meet the requirements of the Table of Limits, Section VIII.

[10] Place door lock plate (27) on door (11) and install bolts (25) into flat washer (26) and install lock washers (24) and nuts (23). Torque to meet the requirements of the Table of Limits, Section VIII.

[11] Place door lock (22) on door (11) and install bolts (20) into flat washers (21) and install lock washers (19) and nuts (18). Install bolts (17) into flat washers (16) and install lock washers (15) and nuts (14). Torque to meet the requirements of the Table of Limits, Section VIII.

[12] Place hinge (13) on door (11) and install bolts (9) into flat washers (10) and install lock washers (8) and nuts (7). Place door (11) on CH and install (9, 10, 8, and 7). Repeat this procedure for door (12). Torque to meet the requirements of the Table of Limits, Section VIII.

CAUTION

Make sure the lifting assemblies are secured to prevent seperation from the control housing during lifting.

[13] Lift and place CH onto the Tank. Install bolts (4) into flat washers (5) and install flat washers (2) and nuts (1). Torque to meet the requirements of the Table of Limits, Section VIII.

[14] Install the vapor vent line (Refer to paragraph 6-4.1.5 steps (15 and 16) according to the procedures in this Section.

[15] Install the service hose.

b. Front Door.

[1] Refer to 6-4.1.10, a, steps 10, 11, and 12.

c. Front Door Hinges.

[1] Refer to 6-4.1.10, a, step 12.

d. Front Door Lock and Lock Plate.

[1] Refer to 6-4.1.10, a, steps 10 and 11.

e. Front Door Lock Catch.

[1] Refer to 6-4.1.10, a, step 9.

f. Front Door Holder.

[1] Refer to 6-4.1.10, a, step 8.

g. Side Door Hinge and Latch.

[1] Refer to 6-4.1.10, a, steps 4, 5, and 6.

h. Hose Bracket.

[1] Refer to 6-4.1.10, a, steps 1, 2, and 3.

SECTION VII
TESTING

7-1 GENERAL.

7-1.1 Scope. This section contains procedures for testing individual components. Procedures are also given for testing after reassembly and repairs of the Tank have been accomplished.

7-1.2 Precautions. All of the following precautions must be observed by personnel conducting the tests outlined in this section. All personnel operating this Tank must be thoroughly familiar with the hazards associated with the handling of cryogenic equipment and its products. The following is offered as a review.

a. Personnel will wear protective clothing as directed in T.O.00-25-172.

b. Do not allow any bodily contact with the liquid product or the extremely cold Tank piping. Following established procedures in the event of accidental contact. Know what to do.

c. Keep the Tank and surrounding area, tools, equipment, and clothing completely free of hydrocarbons.

d. Testing must be accomplished in a well ventilated area. Avoid a concentration of gases from spills and venting.

e. Do not smoke or permit smoking within fifty (50) feet of Tanks in oxygen service. Don't carry sources of flame in the vicinity of Tanks in oxygen service.

f. Keep both liquid and gaseous oxygen away from absorbent materials, loose clothing and rags. These materials can trap oxygen which can later be ignited by any source of spark or flame.

g. Do not allow liquid or gaseous oxygen to vent into areas containing grease, oil, gasoline, kerosene, avaition fuel, or any other hydrocarbons. These substances are not compatible with LOX and if brought into contact spontaneous combustion may result.

h. Never confine the liquid product in any piping or container (e.g. thermos bottle). Without proper pressure relief devices. These containers will explode due to the product building extremely high pressures.

7-1.3 Equipment Operational Safety. The Tank presents several hazards which must be considered by operating personnel. The equipment and product is not necessarily dangerous. Failure to observe normal precautions can lead to serious injury to personnel and damage to equipment.

a. Static Grounding. Prior to use the Tank shall be grounded against the effects of static electricity (Refer to Figure 3-1, Operation and Maintenance Instructions, T.O.37C2-8-29-1).

b. Relief and Vent Valves. Personnel must be constantly aware that vapor or

liquid product may be vented from the Tank at any time. The fill/drain line pressure relief valve (RV-2) is shown in Figure 3-4. The servicing line pressure relief valve (RV-1) is shown in Figure 3-3. The vapor vent line directs gas discharge down and away from the control housing and is shown in Figure 3-6. It must be clear of all obstructions such as plugs, tape, polyethylene bags, and external blockages.

c. Control Valves. The manual control valves are installed in their respective manifolds and are exposed when the front door of the control housing are opened. They should be operated in the manner indicated in T.O.37C2-8-29-1, Operation and Maintenance Instructions.

7-2 MEASUREMENTS AND INSTRUMENTATION.

7-2.1 Accuracy of Measurements. All equipment used in testing shall be of laboratory precision as far as practicable. The equipment shall be calibrated at intervals properly sequenced to continue laboratory accuracy.

a. Indicator Pressures. Data on indicator pressures measured in the range from 0 to 100 psig shall be accurate to within two (2) percent of full scale.

b. Weigh Measurements. Data on product measurements obtained by scale weights of the Tank and the product shall be accurate to within five (5) percent.

c. Gas Flow Rates. Data on gas flow rates shall be accurate to within three (3) percent.

7-2.2 Instrumentation. Tank use requires reading pressures in relation to liquid level and vapor pressure. These indicators are located on the control panel (See Figure 3-7).

a. Tank Pressures. Tank pressures are measured by the vapor phase pressure indicator (PI-1). Tank pressures above atmospheric pressure shall be measured by PI-1.

b. Tank Liquid Levels. Tank liquid levels are measured by the Tank liquid level indicator (LL-1). Tank liquid levels shall be measured by LL-1. The liquid level can be determined by weighing the Tank. Weighing should be measured by scales designed for this particular type of measurement and shall be recorded in pounds. The pound weight may additionally be converted into gallons.

NOTE

LL-1 will not present an accurate indication during filling, draining or pressure buildup operations due to pressure surges. Allow the product to stabilize before recording indicator readings from LL-1.

7-3 TESTING PROCEDURES.

7-3.1 Cleanness Testing. Refer to Section V, Paragraph 5-5.3 for inspection of the interior and exterior of the Tank.

7-3.2 Leak Detection. Leakage, internal and external, is most often detected by visual observation. Frosted piping indicates that product is escaping through a valve. Cold spots on the Tank's outer shell indicates a possible vacuum leak. Frosted valve stems indicates a worn packing or packing nut which needs tightening. These symptons and suggested remedies are listed in Table 5-1, Operation and Maintenance Instructions, T.O.37C2-8-29-1. Small leaks such as losses of 10 to 50 microns of vacuum per day cannot be detected or repaired by ordinary methods.

a. Vacuum Leak Detection. Vacuum leak detection requires contractor or depot facilities, trained and experienced personnel, and the employment of helium mass spectrometer equipment. The following information is only to verify if an inner shell leak does actually exist:

[1] Leakage of the inner shell into the annular space will generally be

indicated by the outer shell safety head (SD-2) located on the rear of the Tank. If it is pushed out then internal leakage is probable. This type of leak cannot be field repaired.

[2] The method of determining the level of vacuum in the annular space is outlined in Section V of the Operation and Maintenance Instructions, T.O.37C2-8-29-1.

NOTE

Report leaking to the proper authorities. Do not attempt makeshift repairs.

b. Pressure Leak Detection. Pressure leak detection consists primarily of pressurizing the piping systems and making a bubble test with Leak Detection Compound MIL-C-25567C (Refer to Table 2-2). DO NOT USE OTHER LEAK DETECTION COMPOUNDS WHICH MAY NOT BE OXYGEN COMPATIBLE (Refer to Figure 1-3).

[1] Obtain a source of clean, dry nitrogen gas (Specification BB-N-411, see Table 2-2) of at least 50 psig.

[2] Using an appropriate hose and fittings attach the nitrogen source to the servicing line (SL) coupling. If the service hose is attached disconnect it from the SL coupling and wrap the end with a polyethylene bag and seal it.

[3] Make sure the SL shutoff valve (V-3) and the SL drain valve (V-4) are closed.

[4] Open the nitrogen source valve and pressurize the SL.

[5] Follow the instructions packaged with the leak detector compound and apply the compound to each threaded connection in the line.

[6] Tighten connections to stop leaks. If tightening fails to stop leakage then disassemble and determine the cause of the problem. Make appropriate repairs as necessary.

[7] Upon completion of the leak test close the nitrogen source valve and open V-4 to drain off the pressure in the hose.

[8] Disconnect the nitrogen source hose and re-connect the service hose.

[9] Attach the nitrogen source hose to the fill/drain line (FDL) coupling.

[10] Make sure the FDL shutoff valve (V-5) and the FDL drain valve (V-6) are closed.

[11] Open the nitrogen source valve and pressurize the FDL.

[12] Repeat previous steps 5 and 6.

[13] Upon completion of the leak test of the FDL regulate the nitrogen source to 50 psig.

[14] Make sure vapor vent line shutoff valve (V-8) and the full trycock valve (V-9) are closed.

[15] Open V-5 and fill the Tank with nitrogen to 50 psig.

[16] Repeat previous steps 5 and 6 for the vapor vent manifold, control panel, pressure buildup coil, and V-9.

[17] After all leak checks and repairs have been made pressurize the Tank to 50 psig and allow it to stabilize for 24 hours at constant temperature. Check indicators for for pressure loss. If the pressure loss is excessive then re-check for leaks.

NOTE

Temperature changes can cause slight variations in Tank pressure and must be considered.

7-3.3 Evaporation Loss Testing. These tests determine the adequacy of the insulation and vacuum in the annular space. This is accomplished by measuring the evaporation loss rate at ambient temperature and pressure. Two (2) methods are offered: one (1) is to successively weigh the Tank and compare the recorded weights, two (2) is to measure the volume of evaporated product.

a. Weight Method. A suitable scale to accommodate the Tank is required. The scale dial should indicate from 0 to 32,000 pounds in increments of 2 pounds.

[1] Position a Tank filled with product on the scale.

[2] Allow four (4) hours for the liquid to stablize.

[3] Weigh the Tank and record the weight.

[4] Allow the Tank to remain on the scale, undisturbed, for 24 hours. Weigh it again and record the weight.

[5] Using substraction determine the evaporation weight loss for the 24 hour period. It must not exceed 19 pounds.

b. Volume Weight. A suitable totalizing flowmeter (See Table 2-1) is required. This flowmeter is usually available from the PMEL or Fuels Laboratory.

[1] Fill the Tank to 50% capacity (1000 gallons) and allow the liquid to stabilize for 12 to 24 hours.

[2] Open the vapor vent line shutoff valve (V-8) and lower the Tank pressure to atmospheric (zero (0) on the vapor phase pressure indicator (PI-1).

[3] Attach the flowmeter to the vapor vent line discharge end and set the flowmeter to zero (0).

[4] Leaving V-8 in the open position allow all of the vapor vented from the inner shell to pass through the flowmeter for a period of 24 hours.

NOTE

The inner shell pressure will remain at, or near, atmospheric as the necessary pressure dropping through the flowmeter will allow.

[5] Record the volume of vapors which have flowed through the meter and calculate (cubic feet of vapors X 13.66 at 70° F) the weight of the evaporated product. It must not exceed 19 pounds.

[6] Disconnect the flowmeter and return V-8 to its normal position for idle storage.

7-3.4 Vacuum Retention Testing. This test is related to both the leak testing and evaportation loss testing. The following procedures are a supplementary verification of those tests results.

a. Testing Procedure.

[1] Fill the Tank with liquid product and allow it to stabilize for four (4) hours.

[2] Following the procedures outlined in Section V of T.O.37C2-8-29-1, Operation and Maintenance

Instructions, use a vacuum gage (Refer to Table 2-1) and determine the vacuum level of the annular space.

[3] Allow the Tank to remain undisturbed for thirty-six (36) and repeat the test of paragraph (2). There must not be any pressure increase attributable to leaks.

7-3.5 Relief Valve Testing. The line relief valves may be tested by attaching them to a regulated source of dry nitrogen gas and increasing the pressure until they open to relieve. The Tank pressure relief valve (RV-3) may be tested by increasing the pressure in the Tank using the pressure buildup control valve (V-7) and noting the pressure at which the valve relieves. RV-3 can be removed from the vapor vent manifold and tested in the same manner as the line relief valves.

CAUTION

Do not attempt to adjust any of the relief valves. The Tank pressure relief valve is a sealed, ASME Code certified unit, do not tamper with it. Failed relief valves should be condemned and disposed of through regular channels.

a. Line Relief Valves. Line relief valves (See 11, Figure 3-3 and 15, Figure 3-4) should relieve and reset at 150 psig.

b. Tank Pressure Relief Valve. The Tank pressure relief valve (34, Figure 3-6) should relieve and reset at 59 psig.

SECTION VIII
TABLE OF LIMITS

8-1 GENERAL.

8-1.1 Scope. This section consist of the Table of Limits. The minimum and maximum are set up as ideal limits and measurements not exceeding the replacement maximum will permit the part to be continued in service. The information presented is miscellaneous as applicable to the Tank.

Table 8-1. Table of Limits.

Item Description	Limits
2 Inch Flange - 5/8 Inch Stainless Steel Bolts/Nuts	50 ft./lbs.
1 Inch Flange - 1/2 Inch Stainless Steel Bolts/Nuts	26 ft./lbs.
1 Inch Flange - 1/2 Inch Carbon Steel Bolts/Nuts	100 ft./lbs.
2 Inch Pipe Clamp - 7/16 Inch Bolt	63 ft./lbs.
1 Inch Pipe Clamp - 3/8 Inch Bolt	36 ft./lbs.
1/4 Inch Pipe Clamp - 3/8 Inch Bolt	28 ft./lbs.
1/4 Inch Bolt	11 ft./lbs.
2 Inch Globe Valve:	
Handwheel Nut	45 ft./lbs.
Packing Nut	30 ft./lbs.
Lock Nut	60 ft./lbs.
Bonnet Nut	240 ft./lbs.
Disc Nut	90 ft./lbs.
Disc Lock Nut	90 ft./lbs.

Table 8-1. Table of Limits-Continued

Item Description	Limits
1 Inch Globe Valve:	
Handwheel Nut	40 ft./lbs.
Packing Nut	30 ft./lbs.
Lock Nut	50 ft./lbs.
Bonnet Nut	180 ft./lbs.
Disc Nut	80 ft./lbs.
Disc Lock Nut	80 ft./lbs.
1/4 Inch Globe Valve:	
Handwheel Nut	30 ft./lbs.
Packing Nut	20 ft./lbs.
Lock Nut	40 ft./lbs.
Bonnet Nut	90 ft./lbs.
Disc Nut	40 ft./lbs.
Disc Lock Nut	40 ft./lbs.
Inner Tank Relief Valve	Set at 59±5 psig
Fill/Drain Line Relief Valve	Set at 150±5 psig
Servicing Relief Valve	Set at 150±5 psig
Inner Tank Safety Head	Rated at 72 psig

SECTION IX
ILLUSTRATED PARTS BREAKDOWN

9-1 GENERAL.

9-1.1 Scope. Refer to T.O.37C2-8-29-4, Illustrated Parts Breakdown, for a complete listing of parts and illustrations.

SECTION X
DIFFERENCE DATA SHEET

10-1 GENERAL.

10-1.1 Scope. No difference data sheets have been prepared for this Tank.